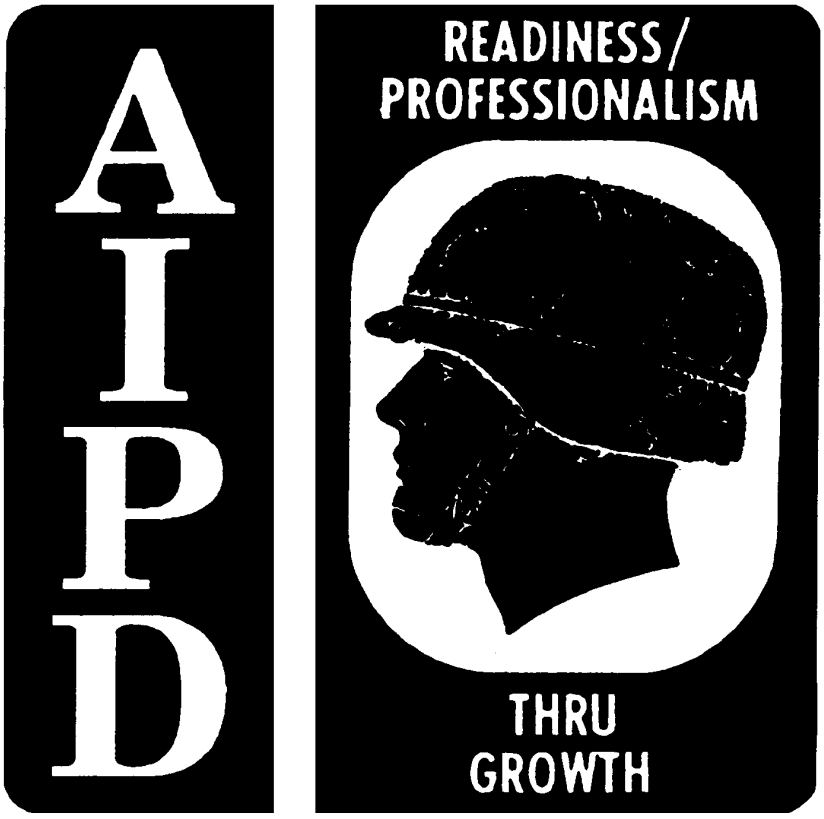
SUBCOURSE
QM 5200

EDITION
A

PETROLEUM OPERATIONS AND APPLICATIONS



THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

PETROLEUM OPERATIONS AND APPLICATIONS

Subcourse Number QM 5200

Edition A

United States Army Combined Arms Support Command
Training Directorate
Fort Lee, Virginia 23801-6000

4 Credit Hours

Edition Date: June 1999

SUBCOURSE OVERVIEW

This subcourse is designed to teach you about Petroleum Operations and Applications. This subcourse will assist you in developing an understanding on how to conduct successful petroleum operations. You will be the petroleum expert.

There are no prerequisites for this subcourse.

This subcourse reflects the doctrine that was current at e time the subcourse was prepared. In your own work situation, refer to the latest official publication.

Unless otherwise stated, the masculine gender of singular pronouns is used to refer to both men and women.

TERMINAL LEARNING OBJECTIVE

ACTION:	You will learn about petroleum operations and petroleum applications.
CONDITION:	You will be the 92F responsible for supervising and ensuring that the proper petroleum procedures are properly executed.
STANDARD:	To demonstrate competency of this task, you must achieve a minimum of 70 percent on the subcourse examination.

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LESSON 1

MARKET CONDITIONS AND COMMERCIAL INTERFACE

Critical Tasks: 03-5103.00-0087
03-5103.00-0098
03-5103.00-0076

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about market conditions and commercial interface, buying cycles, contracts, bids, and procedures use by the DESC.

TERMINAL LEARNING OBJECTIVE:

ACTION: The mission of DESC; market factors affecting the price of petroleum; the four worldwide requirements buying cycles; contract information; the two types of bids used by DESC; the types of contracts used by DESC, and contract administration procedures and responsibilities.

CONDITIONS: IAW the corresponding lesson and listed references.

STANDARDS: Describe the various aspects of how DESC monitors market conditions and interfaces with commercial industries IAW with references and the corresponding lesson.

REFERENCES: DOD 4140.25-M, Vol I - IV and Customer Information pamphlet DESC.

INTRODUCTION

The government agency responsible for buying all bulk petroleum products for all government agencies is the DESC. As a petroleum officer, you may be assigned to a Joint Petroleum Office or to DESC. You must have an understanding of how DESC purchases bulk petroleum products' and interfaces with commercial industries.

1. Market Conditions.

The mission of the DESC is to provide DOD bulk petroleum as cheaply as possible and to provide customer support. Obtaining an economical price is done by tracking the market conditions under which petroleum is sold.

2. Market Factors Affecting Petroleum Purchase Price.

Some factors that cause the price of petroleum to change are:

- The type and amount of product being bought.
- The time of year (season).
- Possible national or international crises.
- National or international policies, (for example an embargo imposing restrictions on the sale of petroleum).
- The current world production level of petroleum.
- Consumer demand.

These are not all the factors that affect the price of petroleum, but are enough to give you an idea of how complex tracking market conditions can be.

3. Market Timing.

DESC monitors the market and tries to "time" purchases of bulk petroleum products to when overall market conditions are favorable. When the conditions are good, a contract to purchase a set amount of product at a set price is offered. The price offered in the contract is based on the price of crude petroleum as listed on the stock exchanges for that day. The goal is to set a reasonable price, not an artificially low price, as when a glut of crude oil is on the market, or an unreasonably high price, possibly due to seasonal demands. The reasonable price goal does two things:

a. It helps attract bids, or offers, for the DESC contract. The supplier is confident that a profit can be made throughout the term of the contract and is willing to make an offer.

b. It helps ensure that the supplier will not renege on the contract. If the price of the purchase was set when there was a glut of oil on the market and then the price of the crude oil returns to its normal range, then the supplier may find it cheaper to renege on the contract and pay penalties to continue filling the contract at the set price.

4. The Four Geographic Buying Cycles.

Factors affecting market conditions are occur in cycles and can be planned. DESC takes advantage of these cycles by dividing its worldwide requirements into four buying cycles. These cycles are defined geographically. They are:

a. Western Pacific. This area consists of U.S. military forces in Hawaii, the Philippines, Japan, Korea, and the Indian and Pacific Oceans. Typically the products purchased are jet fuels, diesel fuels, gasoline, and bulk fuels for ships bunkering and power generation. Contracts are awarded each December for delivery January 1 through December 31.

b. U.S. East Coast and Gulf Coast. Requirements are for JP-5, diesel, gasoline, and fuel oils. Contracts are awarded each March for delivery April 1 through March 31.

c. Atlantic, European and Mediterranean. These contracts supply jet and diesel fuels. Contracts are awarded each June for delivery July 1 through June 30.

d. U.S. Inland and West Coast. These contacts cover jet fuels, diesel fuels, and gasolines. Contracts are awarded each September for delivery October 1 through September 30.

5. Contract Information.

A contract is a written document that is a legal agreement between two or more parties. The DESC uses a contract when buying bulk petroleum products. Contacts set the conditions of agreement between DESC and the supplier. Some conditions set in the contact are:

a. Product Price. The purchase price is based on the price of crude oil as published in the market tables of a named source on a specific date. An example of this is: the price of crude oil as listed in the New York Times futures index for petroleum on March 8th of this year. This is not the only possible source for price listings.

b. Total Amount of Product Purchased. This is the total volume of the purchase. This includes the how, when, and who determines the actual volume of the product that is taken to the delivery point.

c. Product Quality. The DESC has developed product specifications (descriptions of physical characteristics) of each petroleum product. These specifications differ from product to product. A few of the specifications that can be listed are:

- Cleanliness of the product.
- Density of the product.
- Additives required in the product.
- Flashfire point of the product.
- Viscosity (resistance to flow) of the product.

d. Delivery Schedule. The date(s), location(s), and amount(s) of each delivery are set.

e. Default. This refers to a failure of delivery and its penalties. The penalty can range from a fine to cancellation of the contract and removal of the contractor from the DESC list of approved suppliers.

f. Market Condition. Sometimes external factors affecting the price of crude oil shift dramatically for unforeseeable reasons. If a contract had been in place with a reasonable price set and the OPEC cartel cut world production levels of crude petroleum, the price of crude oil would soar. This happened in the 1970's and caused long lines at the gas pumps all across the country. The contractor supplying DESC, through no fault of his own, may not have been able to fulfill the contract due to the dramatic price increase of crude oil. The market conditions clause allows the price to be renegotiated under extreme circumstances to allow a reasonable profit for the contractor. The overall effect is that the flow of product to DESC coffers would continue uninterrupted. Also, if the price was set and then the market price significantly lowered for the duration of the contract then DESC may get a reduction in the price of the product for that contract.

g. Special. Sometimes there are circumstances particular to one contract and an effort will be made to cover these areas to ensure contract completion.

6. Contract Bids.

DESC uses the EDI system to receive contract bids from suppliers. EDI is the computer-to-computer exchange of standardized documents between customers and suppliers. Fuel requirements, solicitations, offers, notifications, awards, funding, billing, payments, orders, shipping, and receipts are also done through using EDI. There are two types of bids on contracts:

a. Sealed bids are used when relatively small amounts of bulk petroleum are bought. The amount of product can be delivered over a few days or weeks rather than months or years. In this form of bid, the specifics of the contract are published in trade publications. Suppliers either accept the terms of the contract or bid or they do not bid on the contract.

b. Negotiated bids are the most widely used by the DESC. The amount of product required and the general time frame needed is published in trade publications. Interested suppliers notify DESC and negotiations are started. During negotiations, the specifics of the contract are determined. DESC determines which supplier best meets the needs of DESC. The contract is finalized and signed. The bulk purchases of petroleum by DESC are frequently so large that the contract may be divided among several suppliers.

7. Types of Contracts.

There are many different types of contracts. Each type is designed to meet the specific and reoccurring needs of the government. Some of the types of contracts are:

a. PC&S Contracts. These contracts cover fuel for ground operations such as diesel, gasoline, heating oil, and related fuel products. DESC awards PC&S contracts on a regional basis by dividing the contiguous United States into eight separate geographic areas with a ninth region for Alaska. Once the contract is in place, the post, camp, or station orders the product directly from the supplier. DESC also solicits fuel for the Federal Services Administration Fuel Yard for deliveries to the White House and federal civilian agencies in the Washington, D.C. area and private citizens. Under PC&S contracts there are three smaller purchase programs for Antarctica, Alaska, and Greenland that support military bases, federal civilian agencies, and private citizens. They are:

(1) ODF -- The National Science Foundation Research Project in Antarctica. The contract for ODF is awarded by November with a one-month delivery period in December.

(2) Northeast Greenland Program. Awarded by June 1 for a delivery window from July 1 through August 31. This program supplies jet fuel, diesel fuel, and gasoline to Thule Air Base in Greenland.

(3) Operation Cool Barge. This program provides military activities and other federal agencies in remote areas of Alaska and the Aleutian Islands Chain with jet fuel, gasoline, and diesel fuel.

b. Bunkers Contracts. These contracts direct delivery of ships' bunkers fuels (fuel for the ships engines and not for delivery to other ships) at 112 U.S. and 42 overseas locations. Delivery of the product is specified free-on-board destination to the ship by either pipeline, barge tank, or truck. Agreements are usually multiyear contacts.

c. Into-Plane Contracts. These contracts are awarded to supply fuel and refueling service to customers at over 300 commercial airports worldwide where military bases with refueling capabilities are not readily available. Any unit requiring more than 15,000 gallons of product to support military and government agencies at commercial locations can take part in this program. Contracts are multiyear agreements. One fourth of the contracts are awarded during a two-year cycle beginning either April 1 or October 1.

d. Alongside Aircraft Refueling Contracts. These provide the necessary labor and equipment to refuel aircraft of all types, including helicopters, at about 30 Navy, Army, and Marine Corps installations using government-owned fuel. At some locations the contractor may also operate the tank farm. The military services fund these contracts which are usually awarded for one year. DESC is now soliciting multiyear contracts as well.

e. Coal Contracts. DESC purchases 1 million tons of coal annually for about 50 military installations in CONUS, Alaska, and Europe. All contracts are administered by DESC, except for the European contact which is administered by the Army. Contractors bill the customers directly for all orders placed. Coal contracts are for one to two years, except for Alaska which is for five years. Coal contracts have price increase provisions for wages, transportation, and land reclamation expenditures.

f. Bulk Lubes Contracts. These are indefinite quantity contacts and direct delivery to about 21 activities in the CONUS, Hawaii, Guam, and Japan. DESC administers all contracts except for the ground vehicle lubricating oils. For these, the DERs order the requirements for their customers using DESC funds. The customers are then billed at a later date.

g. Natural Gas Contracts. These contracts direct delivery of natural gas to posts, camps, and stations as well as to various civilian activities. Gas is normally purchased and delivered via interstate pipelines to the local distribution companies boundary. Pipeline service is usually purchased as a-part of the contract. The customer contracts separately with the local company for gas transportation from boundary to the military base.

h. Storage Contracts. These contracts cover the receipt, storage, and shipment of government-owned fuel in the CONUS including 16 COCO facilities. Outside the continental United States, the storage contracts include 18 COCOs and 9 GOCO facilities. Contracts are fixed price and last three to five years.

i. Overseas Service Contracts. DESC also awards and administers six COCO lab testing contracts, one transportation contract, one naval mooring service, and one GOCO lab in Korea.

j. Credit Card Contracts. These contacts are used to purchase gasoline and lubricants for automobiles, aviation gasoline, and jet fuel. These contracts operate on a five-year cycle. Base contracts are for one year with four one-year options.

k. Strategic Petroleum Reserve. In 1989, DESC reassumed procurement responsibility for the nation's SPR. The SPR is used to store crude oil as a buffer against potential national emergencies. The total reserve is 1 billion barrels. DESC purchases the crude oil for the Department of Energy, which stewards the reserve.

8. Contract Administration and Responsibilities.

DESC uses the DFAMS to control the flow of petroleum products from procurement through storage and transportation to final sale to the customer. DFAMS provides information on the status of DESC contracts, funds, inventories at Defense Fuel Support Points, contractor payments, and customer billing.

a. DESC has procurement responsibility for all petroleum contracts. Contact administration responsibility for bulk petroleum products is retained by DESC. However, with the DESC Commander's approval, the DESC-P may assign contract administration functions to another DLA activity by designating the activity as the CAO on the contact. DESC assigns a KO to each contact Additionally, DESC may designate the requiring service to provide certain functions.

b. The KO is the central coordinator for contract administrative matters. The KO may delegate contact administration functions to DERs. The KO also appoints COR. The KO must ensure that the COR has qualification and experience equivalent to the authority which the COR will exercise. There are certain responsibilities that the KO cannot delegate. They are:

(1) Changes to the contact that affect delivery schedules, specifications, quantities, prices, or changes in extent or nature of service.

(2) Resolve issues of contractor performance.

(3) Resolve matters requiring formal recognition by contact, contact change, or findings and determinations.

(4) Resolve disputes between contractor and the U.S. Government.

(5) Resolve complaints by contractors or military services.

c. CAOs provide contact administration services within designated geographic areas.

d. The COR monitors contractor performance and initiates corrective action as authorized in his letter of appointment. He is an "on site" representative of the KO.

e. Military services may be designated by DESC to be responsible for:

(1) Placing orders and requests for orders and services.

(2) Performing quality surveillance at terminals.

(3) Performing other functions as required in the contact or designated by DESC.

f. DOD components/Federal agencies are authorized to local purchase petroleum products under the following conditions:

- Annual Requirements (For example petroleum price fluctuation).
- PC&S contract bulletins.

- Emergency conditions.
- Ship bunkers.
- Aviation fuel.
- Military Convoys.

LESSON 1

PRACTICE EXERCISE

The following items will test your gasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answer with the answer key that follows. If you answer any item incorrectly study again that part of the lesson which contains the portion involved.

1. What is the mission of DESC?

A. To work with the S&S officer
B. To provide DOD and customers bulk petroleum a cheaply as possible and to provide customer support
C. To provide the battalion S4 with a report
D. To provide the DSC with aid for the DESC

2. What are some of the factors that determine the price of petroleum?

A. Amount of petroleum and location of region
B. Cost and the consumer
C. Type and amount of product; national or international crises; embargoes; consumer demand; world production levels
D. Budgetary constraints and location and local EPA laws

3. How does setting a reasonable price help DOD?

A. It helps ensure that the contractor will not renege on the contract.
B. It makes it easier for units to request fuel.
C. It discourages bids for DESC contracts.
D. If we don't like the prices then the KO can cancel the contract.

LESSON 1

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. B. To provide DOD and customers bulk petroleum as cheaply as possible and to provide customer support (page 1-2, para 1).

2. C. Type and amount of product; national or international crises; embargoes; consumer demand; world production levels (page 1-2, para 2)

3. A. It helps ensure that the contractor will not renege on the contract (page 1-2, para 3b)

LESSON 2

FIRE, SAFETY, AND FIRST AID

Critical Task: 01-5103.30-2120

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about fire, safety and first aid. You will also be instructed on how to properly fill a tank, charge (pressurize) the system, and discharge the system to extinguish a petroleum fire.

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe methods of controlling or eliminating vapor formation, sources of ignition, and sources of static electricity, selecting the proper type of fire extinguisher for each class of fire, identifying health hazards dealing with petroleum products as well as first aid procedures.

CONDITIONS: Given the appropriate instruction and references.

STANDARD: Describe the proper fire, safety and first aid procedures IAW the given references and corresponding lesson plan.

REFERENCES: The material contained in this lesson was derived from FM 10-67-1, and FM 10-67-2.

INTRODUCTION

Because of the very nature of petroleum products, there are many hazards involved in the handling and storing of them. The greatest and most obvious is fire. However, we must not overlook the many health and safety hazards besides fire that are also present when operating a petroleum facility. In this lesson, we will discuss how we can prevent loss of life and property caused by these hazards through the application of proper safety procedures.

1. Fire, Safety, and First Aid.

The number of fires caused by uncontrollable natural reactions is minimal compared to those caused by human carelessness and lack of the interest in the characteristics, chemistry, and physics of fire. Knowledge of the principles of fire can help in extinguishing those fires whatever the source.

2. Nature of Fire.

Fire is a rapid chemical reaction that releases heat and light, especially the releasing of heat from the combination of a combustible substance with oxygen.

Fire is the process of chemical oxidation and combustion who's elements consist of fuel, oxygen, and heat. These three elements are commonly referred to as the fire triangle. When all three elements of the fire triangle are intact, and in the proper state and proportion, burning can take place, and when any of these elements are removed, the burning will stop.

3. Properties of Fire.

a. Ignition Temperature. Ignition temperature of a substance (solid, liquid, or gaseous) is the minimum temperature to which the material exposed to air must be heated in to initiate or cause a self-sustained combustion. Ignition temperature of the same material varies according to the percentage composition of the vapor air mixture, shape, and size of space where the ignition occurs, rate and duration of heat, temperature of the ignition source and oxygen concentration.

b. Vapors. Vapors in the process of combustion are the gaseous substance given off by the material that is burning. In burning wood, heat causes the resinous substance in the wood to vaporize. The vapors combined with the oxygen and the flame from the kindling ignites the combustible vapor-oxygen gas. The heat from the fire heats the wood, which in turn creates more vapors and thus sustains the fire until the wood is consumed.

c. Vapor Explosive Range. When vapors from petroleum products are mixed with the proper amounts of air (oxygen), they form explosive mixtures within a limited range. This range is usually called the explosive range or explosive limits. (As used here, the word "explosion" means the instantaneous burning of a mixture of flammable material and oxygen.) Gasoline vapors form explosive mixtures when mixed with air in a range from about 1 to 8 percent by volume. This mixture within the explosive range ignites at once when it comes in contact with a spark or flame.

(1) Upper explosive limits. A vapor-air mixture with more than 8 percent gasoline vapor is beyond the upper limit and it does not ignite.

(2) Lower explosive limits. A vapor-air mixture with less than 1 percent gasoline vapor does not ignite.

4. Source of Ignition.

Source of ignition is any substance that can produce heat or a spark. Volatile petroleum fuels vaporize at normal atmospheric temperatures, and the vapors burn readily when ignited. All fires connected with flammable products result from the ignition of vapors. There is little danger in a closed container that holds a flammable product unless it is exposed to heat. The hazard arises from tie ignition of vapors produced during transfer or use of petroleum products and those resulting from spills or leaks. Fuel handles must remember that air and fuel are present in all operations they perform. Heat is all that is needed to case a fire or an explosion. The best way to prevent petroleum fires is to reduce vapor formation and control sources of ignition. Some of the most common sources of ignition and control measures are as follows:

a. Smoking and Matches. Collect all smoking materials at the entrance checkpoint. Post "No Smoking Within 50 Feet" signs where they can easily be seen.

b. Poor Housekeeping. Keep the area free of trash and similar combustibles that can be ignited by small sources of heat.

c. Mechanical or Friction Sparks (impact between metals).

d. Electrical Equipment (arcs and sparks or overheating). Inspect and use only explosion-proof electrical equipment that complies with Underwriters' Laboratory Incorporated standards when there is the possibility of flammable vapors.

e. Spontaneous Combustion (self-ignition of combustible materials caused by accumulation of heat though slow oxidation of its own material; for example, oil or paint-soaked waste and rags). Place waste and rags in airtight metal containers.

f. Welding and Cutting. Clean and vapor-free equipment to be welded or cut.

g. Static Electricity (electricity generated by friction between two unlike substances). Prevent sparks by bonding and grounding.

(1) Bonding is an electrical connection between metallic containers or equipment to equalize their static potential.

(2) Grounding is an electrical connection between one or both of the bonded transfer units and the ground. This action dissipates electrical potential into the ground through the use of a conductive wire and a grounding rod. In some warm areas, rocky or sandy soil makes it hard to get a good ground because such soil has low conductivity. Chemicals, to include sodium chloride (common table salt), can be used to condition the soil to raise its conductivity. To use table to raise conductivity follow this method:

(a) First, dig a hole about 1 foot deep and 3 feet across.

(b) Mix 5 pounds of salt with 5 gallons of water.

(c) Pour the mixture into the hole, and allow it to seep in.

(d) Install the ground rod and wire, and keep the soil moist around the rod.

(3) Lightning s a massive discharge of static electricity. Cease all operations immediately whenever there are lightning discharges within the vicinity.

5. Classes of Fire.

Fires are divided into four main classes. The Underwriters' Laboratories, Incorporated, groups fires into Classes A, B, and C. The National Fire Protection Association groups them into Classes A, B, C, and D. These classes are based on the combustion characteristics of the ignited material. In most cases, installation fires are combinations of at least two and sometimes all of these classes.

a. Class A. Fires occur in ordinary combustible materials such as bedding, books, cloth, wood, brush, grass, and rubbish. This type must be dealt with by cooling (water) the fire below its ignition temperature. All class A fires leave embers which are likely to rekindle if air comes in contact with them. Therefore, this type of fire must not be considered extinguished until the entire mass has been cooled thoroughly.

b. Class B. Fires occur in flammable substances such as gasoline, jet fuels, grease, oils, paint, tar, and other combustible substance which do not leave embers or ashes. A smothering or diluting agent is the best agent for putting out class B fires.

c. Class C. Fires occur in electrical equipment such as motors, switches, transformers. It can also occur in the electrical system of an aircraft during rapid refueling operations. These fires present an extra hazard because of the danger of electrical shock. A smothering agent is best for use on class C fire, but the agent must not be a conductor of electricity. Carbon dioxide is preferred for this type of fire. The first step in extinguishing class C fires is to turn off the source of power.

d. Class D. Fires occur in combustible metals such as titanium, zirconium, sodium, and potassium. The greatest hazard exists when these metals are in the molten state or in finely divided forms of dust trimmings, or shavings. Ordinary extinguishing agents are ineffective on these metal fires, and they are best controlled by covering with special dry powdered or granular materials which exclude oxygen and which will not react or combine adversely with metal.

6. Types of Fire Extinguisher. The Army uses portable hand-held fire extinguishers, wheel units and skid-mounted units at small petroleum operations and terminal operations. Hand-held extinguishers are available in many sizes and types. They are most effective in the early sages of a fire. Wheeled and skid-mounted units have a greater capacity than the hand-held. The fire extinguishers common to petroleum operations are described below:

a. Carbon Dioxide (CO2). CO2 is a gas about 1 1/2 times heavier than air. It is nonpoisonous and will not support combustion. C02 converts into a liquid when under pressure in an individual extinguisher tank. When discharged, the chilling effect turns about 30 percent of the charge into dry ice or snow. This occurs because of expansion. CO2 dilutes or smothers class B fires by cutting off the oxygen. It also works well with class C fires because it is not a conductor of electricity. This extinguisher is effective from 3 to 8 feet.

b. Dry Chemical. Fire extinguishers are of two types, consisting primarily of treated sodium bicarbonate powder treated with additives to make it waterproof and free flowing. One type is pressurized with 150 PSI of dry nitrogen or dry air, and the other has a cartridge of pressurized carbon dioxide. The extinguisher puts out the fire by smothering. It works well with class B and C fires.

c. Purple K. Extinguisher is a dry chemical extinguisher using the agent potassium bicarbonate (KHCO3), commonly called purple K. Carbon dioxide gas discharges the agent in a wide stream from a low-velocity nozzle. It works by smothering fires and is designed for use on class B and C fires. Purple K is highly corrosive.

d. Fire Suppression Assembly (Twin Agent Unit). This is a self-contained dry chemical and aqueous film forming foam fire extinguisher. The skid-mounted or wheel-mounted frame of the extinguisher holds two independent fire-fighting systems. One is the dry chemical (potassium bicarbonate or PKP) system, and the other is the AFFF system. Pressurized nitrogen propels the agents from their tanks. The first agent to be discharged in a petroleum fire is the Purple K to extinguish the flames. Then the AFFF solution is applied, where the foam forms a film over the area to prevent re-ignition. The TAU can extinguish a fire in a 1,500 square feet berm. The extinguisher is effective from 40-50 feet and at least two (preferably three) people to operate the unit. The components are:

(1) Dry chemical tank. The tank is made of steel and is designed to hold 450 pounds of chemical agent at 220-240 PSI operating pressure.

(2) AFFF tank. This tank is made of steel and is designed to hold 100 gallons of AFFF mixture, (6 gallons. AFFF concentrate to 94 gallons of water), at 220-240 PSI operating pressure. An electric heater is mounted on the outside of the tank to heat the solution when tank temperature falls below 45°F.

A temperature relief plug, fusible at 203°F, is installed at the bottom of the tank, in contact with the AFFF. Each system is equipped with a N2 pressure regulator preset at the factory to reduce N2 pressure to 220-240 PSI. A nonadjustable pressure relief valve, preset to 250 PSI, is installed on the plumbing of each tank in case of a complete regulator failure.

(3) Two nitrogen (N2) cylinders. When fully charged, contain 300 cubic feet of N2 at 2400 PSI. A minimum of 1750 PSI is required for operation. Each cylinder is equipped with a quick-opening lever and a 0-3,000 PSI gage installed on the valve.

(4) Hose assembly (twinned handline). This transmits the agents from the tanks to the twinned discharge nozzle assembly. The assembly consists of two, 150-foot non-collapsible hoses, encased in a woven polyester jacket. Also it has a wheeled remote hose cart with an additional 150 feet that can be connected to the mounted reel to extend its capability to 300 feet.

7. Health Hazards. Health hazards are inherent in petroleum products. You cannot eliminate them, but you must be aware of them and use precautions. Most petroleum health hazards can be classified according to the form the contaminant takes.

a. Dusts. These are solid particles of substances that result from mechanical operations such as grinding, scraping, buffing, cutting, drilling, sanding, or sand-blasting. Dusts are divided into three types:

(1) Toxic dusts injure the organs and tissues of the body when they are inhaled into the lungs. If ingested into the digestive system, they attack the body through the liver. Certain toxic dusts may also irritate the skin. Lead, manganese, mercury, arsenic, and their compounds make toxic dusts. One of the most toxic is produced when cleaning and repairing tanks that contained leaded gasoline. Lead dust and fumes also result from burning sludge from leaded gasoline. The body can resist lead poisoning if it is given enough time between exposures. Personnel should be tested periodically for lead poisoning.

(2) Fibrosis producing dusts injure the lungs in such a way that normal tissue is replaced with fibrous or scar tissue. The most common is dust containing silica, from grinding and polishing machines or sanding and sandblasting equipment. It causes the disease called silicosis.

(3) Nuisance dusts may not cause severe injury, but they may cause inflammation and respiratory ailments. Personal allergies may add to the effect of dusts.

b. Gases and Vapors. The term “gas” and “vapors” are often used to mean the same thing, although there is a difference. A gas exists as a gas at ordinary temperature and pressure. A vapor is a gas-like form of a substance that is ordinarily a solid or liquid. Gases and vapors are divided into four groups.

(1) Poisonous or Toxic -- have various effects on the body. They may injure or destroy the visceral (intestinal) organs, the blood-forming system, tissues, or bones. Toxic effects often show up only after prolonged exposure. The most poisonous are hydrogen sulfide (found in crude oils with high sulfur content) and tetraethyllead (found in leaded gasoline). You must avoid exposure to them at all times, because they can kill you. Personnel exposed to hydrogen sulfide may lose consciousness and never regain it. Other gases, listed in order of toxicity, are sulfur dioxide, ammonia, methyl bromide, butane, propane, and the freons. These gases are often used as refrigerants.

(2) Asphyxiants -- keep the lungs from getting oxygen. They replace the oxygen in the air. Some asphyxiants are methane and its related hydrocarbons, hydrogen and acetylene which are used in welding and flame-cutting. A chemical asphyxiant like carbon monoxide gas interacts with blood in such a way that the blood is unable to absorb enough oxygen to sustain the organs of the body, which causes the organs to fail.

(3) Anesthetics -- have a narcotic effect which depresses the central nervous system to a point where respiratory failure may occur. All hydrocarbon vapors have this effect. The most narcotic are acetone, the ethers, benzene, naphthas, gasolines, and jet fuels. Other anesthetics are hydrocarbon derivatives that contain members of the chlorine family. Exposure to burning hydrocarbon vapors can cause tremors of the heart ventricles.

(4) Irritants -- inflame the lungs and respiratory tract. They may cause pneumonia and other pulmonary diseases or make the victim more susceptible to them. Most flammable gases and vapors are irritants whether they are poisonous, narcotic, or neither.

c. Liquids. -- Flammable liquid products can cause internal medical problems if swallowed. Even the skin can become contaminated if direct contact with these products occur.

(1) Inside the body -- flammable liquids are dangerous if you get them in your mouth and may be fatal if you swallow them. If you get petroleum in your eyes or mouth, flush them thoroughly and repeatedly with water. Do not induce vomiting. Get medical help.

(2) On the skin -- flammable liquids also cause skin contamination. The seriousness depends on the substance. Effects from gasoline, jet fuel, and solvents are less serious, but it must not be taken lightly. Fuels, solvents, paints, lacquers, and varnishes dry up natural fats and oils on the skin. This leaves the skin harsh, dry, and chapped, (a condition known as dermatitis). These unnatural skin openings or lesions increase your chances of infection. If you get petroleum on your skin, wash it off at once with soap and water. If your clothes are soaked with fuel, wet them with water before you take them off. If you do not have any water, temporarily ground yourself by taking hold of a grounded piece of equipment, then take your clothes off. Grounding yourself protects you from the danger of a static spark igniting your clothes as you remove them.

d. Fumes and Mist. The term “fume” is often used to mean the same thing as gas and vapor. It is more correctly used to mean, to transform directly from a solid to a gaseous state or from the gaseous to the solid state without becoming a liquid. This process is called sublimation.

e. Oxygen Deficiency. This means that the air you breathe lacks the normal amount of oxygen. This is a health hazard when working with petroleum products. Normal air contains about 21 percent oxygen. Personnel working in a concentration of only 17 percent will breathe a little faster and deeper. The flame of a safety lamp goes out when the concentration falls to 16.25 percent. Life is in danger when the concentration level drops to 7 percent.

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LESSON 2

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What elements are needed to start a fire?

   A. Fuel, oxygen and heat
   B. Oxygen and oil
   C. Heat and Oxygen
   D. Heat only

2. What is grounding and its purpose?

   A. Making sure all of your equipment is properly laying on the ground
   B. An electrical connection between one or both of the bonded transfer unit and the ground to dissipate electrical charges
   C. Clearing away trash and hazardous material on the ground around a fuel tanker
   D. Making sure that you have an electrical current going into the fuel in your fuel tanker

3. What is considered a class B fire?

   A. Fires that water can put out
   B. Fires that do not involve gasoline, jet fuels, oils, paint, tar and other combustibles
   C. Fires that spontaneously combust
   D. Fires that involves gasoline, jet fuels, grease, oil, paint, tar and other combustible materials that does not leave embers or ashes

LESSON 2

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. A. Fuel, oxygen, and heat. (page 2-2, para 2).

2. B. An electrical connection between one or both of the bonded transfer unit and the ground to dissipate electrical charges. (page 2-3, para 4g(2)).

3. C. Fires that involves gasoline, jet fuels, grease, oil, paint, tar and other combustible materials that do not leave embers or ashes. (page 2-4, para 5b).

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LESSON 3

ORDERING, REQUISITIONING, AND SLATING

Critical Tasks: 01-5103.30-2045
03-5103.00-0024
03-5103.00-0076
03-5103.00-0087
03-5103.00-0093
03-5103.00-0098
03-5103.30-1147

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about ordering, requisitioning, and slating. You will also learn the purpose of slating, the use of CONUS and overseas slates, how to prepare overseas slates, and how to monitor requirements balances and unforeseen changes.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify he purpose of the slate, use of CONUS and overseas slates, slating activities, preparation of overseas slates, monitoring requirements balances, and unforeseen changes.

CONDITIONS: You will be given instruction that will provide you with the knowledge needed to supervise and prepare a slate.

STANDARDS: To demonstrate competency of this task during the final examination IAW DOD Manual 4140.25.

REFERENCES: DOD 4140.25M, Vol II, DESC Handbook 4140.4 (Tanker Data Elements Code), and DESCH 47051.

INTRODUCTION

As petroleum managers, you must be knowledgeable of the petroleum distribution system. Slating plays a key role in the distribution system. For petroleum to enter a theater of operations, a slate must be prepared in advance. The slate is the theater's request for petroleum products. In this lesson, we will discuss how petroleum product requirements are submitted and monitored by the theater joint petroleum office.

1. Terms.

a. Ocean Terminal -- a terminal capable of discharging and loading cargo (for example, ocean/coastal tank vessels).

b. Slate - monthly reports of planned requirements for tanker delivery. Submitted monthly by electronic transmission by the JPOs, DEO, or DERs to DESC.

c. Slate Items -- high usage petroleum products slated through JPO channels for use in overseas areas. The most common slated items are under FSC 9130 (gasoline), and 9140 (diesel and kerosene). An optional FSC would be 9150 (packaged petroleum products) or additives (6850) such as FSII or Static Inhibitor.

2. Purpose of the Slate.

a. Resupply Ocean Terminals -- A slate is a request for a quantity of fuel, by product type, to be delivered by a specified means (MSC - tanker, commercial tanker, at a specified period.

(1) A slate projects future requirements.

(2) From the slate, a WAS is developed. This schedule projects what tankers will arrive at what ocean terminal on what date.

b. Establish Requirements. A slate projects requirements four or five months out. The first and second month requirements must be firm, subject to minimal change, since shipping arrangements are made 30 to 60 days in advance.

(1) The requirements for later months are future projections and these requirements become refined/perfected as their time period gets closer. Therefore, the slate sets up requirements for products and tankers.

(2) The early months are accurate requirements and the later months are a “heads up” notice.

3. Efficient Tanker Distribution.

a. As mentioned earlier, the early months of the slate are accurate requirements. Shipping arrangements are made 30 to 60 days in advance of the delivery date, thereby dedicating vessels to meet the requirements.

b. The later months are used to schedule tankers 30 to 60 days in advance for the requirement.

4. CONUS Slate.

a. Use CONUS slates are used to schedule the movement of bulk products to ocean terminals within CONUS.

b. Four-Month Requirement. The CONUS slate sets up requirements for the current plus three subsequent months.

c. Tanker Movements of Product to CONUS Terminals DESC consolidates requirements from all CONUS DERs. Tanker movements to all water terminals are developed from these slates.

d. Format. CONUS slates are prepared and submitted through DFAMS.

5. Overseas Slate.

a. Use. Overseas slate are used to schedule the movement of bulk petroleum products to ocean terminals outside of CONUS.

b. Four-Month Requirement. The overseas slate sets up requirements for the current plus three subsequent months.

c. Submission. The slate must be received at DESC NLT the 10th calendar day of each month. In order for this to be done, JPOs, DEOs, or DERs transmit the slate via any electronic means (message or facsimile)

d. Format. There is no set format for the overseas slate.

6. Slating Activities. The following activities are responsible for slating bulk petroleum in their areas of responsibility:

a. CONUS.

(1) DEO Fort Dix.

(2) DEO Los Angeles.

(3) DEO Houston.

b. OCONUS.

(1) DER Europe (For EUCOM).

(2) PACOM JPO.

(3) DER Middle East (For CENTCOM).

(4) SOUTHCOM JPO.

(5) USACOM JPO.

c. Miscellaneous Activities.

(1) HQ Space Command (Greenland).

(2) SA-ALC (JPTS).

(3) Antarctic Support Associates.

7. Preparation of the Overseas Slate.

Requirements Information: Reflects the type of product required by quantity, during a specific period of the month, at a specific location, and by a specific delivery method. The following information is required:

a. Month.

b. Destination Terminal Code (DESCH 4705.1, pg 14).

c. Product Type -- three characters (MG2, DFM) (DESCH 4705.1, pg 9)

d. Quantity -- expressed in mike barrels.

e. Method of Delivery Code.

f. Period -- delivery desired.

8. Method of Delivery Codes.

a. 1 -- MSC controlled tankers/barge.

b. 2 -- Commercially controlled tankers making FOB destination shipments.

c. 3 -- Pipeline tankcar, tank truck, barge deliveries arranged by other than MSC.

9. Period of Delivery Codes.

a. 1 -- 1st thru 10th day of month.

b. 2 -- 11th thru 20th day of month.

c. 3 -- 21st thru end of month.

d. 4 -- Blank. No preference.

10. Requirements Footnotes.

Footnotes will be used to convey information not included in the slate format:

a. Changes in storage capacities resulting from such factors as removal of tankage for tank cleaning, maintenance, repair, or abandonment.

b. Special requirements, restrictions, or limitations relative to usage, storage facilities, pipeline distribution schedules, draft, safety regulations, and port congestion which affect tanker operations.

c. Significant changes in requirements such a changes due to requirements balances.

11. Requirements Balance.

a. Some variations can be expected between the quantity slated and the quantity actually delivered during a calendar month by tankers with DESC cargo numbers designations. The quantity on the tanker may not equal the quantity requested on the slate. The difference between ordered and received is reported as a "POSITIVE", "NEGATIVE", or "ZERO" requirements balance.

(1) If the quantity delivered is less then the quantity slated, the requirements balance would be NEGATIVE.

(2) If the quantity delivered is greater then the quantity slated, the requirements balance would be a POSITIVE.

(3) If the quantity delivered is the same as slated, than the requirements balance would be ZERO.

b. The requirements balance must be computed and considered when the slate is being prepared.

(1) If the requirements balance is ZERO, no adjustment to the slate is required.

(2) If a negative requirements balance is already scheduled, no further action is required.

(3) If the negative requirements balance is not scheduled, disregard it and compute the slate based on customer needs and available storage.

(4) If there is a positive requirements balance, review the slate and decrease or cancel order based on customer needs and available storage.

The following is an example of the requirements balance.

Terminal X (JP8)

Month	JUN (BBL)	JUL (BBL)	AUG (BBL)	SEP (BBL)
Slated Qty	100	120	90	125
Delivered	100	100	120	115
Req. Bal.	0	- 20	+ 10	0

JUN - The slated quantity was equal to the delivery quantity. Assuming the previous months' requirements balance was zero, the slate for July would reflect a requirements balance of ZERO for JP8 at ocean terminal X. No action is required to change scheduled deliveries.

JUL - The slated quantity was 120 Mbbl but only 100 Mbbl were delivered. This leaves terminal X, 20 Mbbl short. June requirements balance was ZERO, the slate for August will reflect a NEGATIVE requirements balance 20 Mbbl of JP8 at ocean terminal X, providing storage (ullage) is available. Check the tanker schedule to see if the difference has been scheduled for delivery. If it has, no further action is required. If not, change the slated quantity to reflect the NEGATIVE balance if supported by customer needs and available storage.

AUG - The slated quantity was 90 Mbbl, but 120 Mbbl were delivered. This difference, 30 Mbbl brings the requirements balance to (POSITIVE) 10 Mbbl. The slate for September will reflect a requirements balance of (POSITIVE) 10 Mbbl. Note: The slate for September did not reflect a requirements balance of 30 Mbbl because July's requirements balance of (minus) 20 Mbbl was considered in determining August requirements balance (for example: -20 + 30 = +10).

12. Unforeseen Changes.

a. Changes caused by requirements balances, and circumstances beyond the terminal's control can have an impact on delivery requirements. These unforeseen changes can require a change in the delivery requirements.

b. If a change affects delivery requirements during the first two months of the current slate, it is reported through the JPO to DESC by the most expeditious means available. A change to the first two months requires a follow-up submission of a slate change, and explanation of the change will be in the footnotes section.

c. If the changes affect the third and/or fourth months, the next month's slate should reflect corrections in quantities and in the footnotes.

LESSON 3

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved

1. A slate is a projection of the current month and how many months into the future?

   A. Two months
   B. Three months
   C. Six months
   D. Nine months

2. What reference lists ocean terminals both alphabetically and by code?

   A. FM 10-67-1
   B. DESC Handbook 4140.4 Tanker Data Elements Code
   C. FM 10-52
   D. FM 10-67

SITUATION: The date is 30 Sept xx. You are the Joint Petroleum Officer for US Pacific Command. The Defense Energy Region has requested that you prepare the slate for the month because they are all going to Fort Lee for a petroleum conference. The following requirements were identified and slated in Sept XX:

a. Pearl Harbor, Hawaii -- All deliveries to be made by MSC tanker.

   1 Oct - 10 Oct XX - 300,000 bbl JP8; 10,000 bbl DF2; 600,000 bbl JP5

   11 Oct - 20 Oct XX - 200,000 bbl JP5

   21 Oct - 31 Oct XX - 150,000 bbl F76

b. Okinawa -- All deliveries to be made by MSC tanker except for 600,000 bbl of JP5 by commercial tanker.

   Nov - 10 Nov XX – 500,000 bbl JP8

   11 Nov - 20 Nov XX - 600,000 bbl JP5

   21 Nov - 30 Nov XX - 300,000 bbl JP5; 300,000 bbl F76; 300,000 bbl DF2

c. Inchon, Korea - All deliveries to be made by MSC tanker.

1 Dec - 10 Dec XX - 600,000 bbl JP8; 1,200,000 bbl JP5

11 Dec - 20 Dec XX - 350,000 bbl DF2; 560,000 bbl F76

21 Dec - 31 Dec XX - 250,000 bbl JP8

d. The following requirements are needed at the terminals as indicated

1 Jan - 10 Jan YY - 350,000 bbl JP5 at Barbers Point, Hawaii - delivered by MSC barge.

11 Jan - 20 Jan YY - 250,000 bbl JP5 at Kanohe, Hawaii - delivered by commercial tank truck.

21 Jan - 31 Jan YY - 250,000 bbl P8 at Kwajalein, Marshall Islands - delivered by MSC barge.

Special requirements/changes:

For October,

- Month of October - 800,000 gallons of jet fuel has just been requested for the USS Enterprise. The DESP projects that it will have enough storage space available on 12 Oct ad requests that the fuel be delivered at Pearl Harbor after that date. The Enterprise is due in on 18 Oct. This requirement has not been identified on previous slates.

- The requirements balance for September for F76 at Pearl Harbor is (-) 50 Mbbl and it is NOT scheduled.

- The requirements balance for September for JP5 at Okinawa is (+) 100 Mbbl. Available storage at Okinawa for JP5 is 800 Mbbl.

- The harbor at Okinawa will be closed 1-15 January YY for dredging the harbor.

3. Prepare the October XX slate based on the above information. Adjust the slated quantities for the requirements balances and changes as needed. Use the attached format for preparing the slate.

USPACOM Slate for October XX

MONTH	PRODUCT	QUANTITY MBBL	DESTINATION	DELIVERY PERIOD	MODE

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LESSON 3

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. B. Three months. (page 3-2, para 4b).

2. B. DESC Handbook 4140.4 Tanker Data Elements Code. (page 3-1, reference listing).

3. Answer given below, (See Example, page 3-5 to 3-6).

USPACOM Slate for October XX

MONTH	PRODUCT	QUANTITY (Mbbl)	DESTINATION	DELIVERY PERIOD	DELIVERY MODE
Oct	JP8	300	PERL	1	1
Oct	DF2	100	PERL	1	1
Oct	JP5	600	PERL	1	1
Oct	JP5	220	PERL	2	1
Oct	F76	200	PERL	3	1
Nov	JP8	500	OKIN	1	1
Nov	JP5	500	OKIN	2	2
Nov	JP5	300	OKIN	3	1
Nov	F76	300	OKIN	3	1
Nov	DF2	300	OKIN	3	1
Dec	JP8	600	INCH	1	1
Dec	JP5	1,200	INCH	1	1
Dec	DF2	350	INCH	2	1
Dec	F76	560	INCH	2	1
Dec	JP8	250	INCH	3	1
Jan	JP5	350	BARP	1	1
Jan	JP5	250	KANE	2	3
Jan	JP8	250	KWAJ	3	1

Footnotes:

1. Quantity for JP5 for PERL during Oct period 2 increased to 219 Mbbl for USS Enterprise.
2. Quantity for F76 at PERL during Oct period 3 increased for _50 Mbbl requirements balance.
3. Quantity for JP5 for OKIN during Nov period 2 decreased for (+)100 Mbbl requirements balance.
4. Harbor at OKIN will be closed.

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LESSON 4

BULK PETROLEUM WAR RESERVE STOCKS

Critical Tasks: 03-5103.00-0087
03-5106.00-0135

OVERVIEW

LESSON DESCRIPTION:

In this lesson you will learn about POS, BPWRS, IMP, and the activities involved in planning the IMP and their responsibilities.

TERMINAL LEARNING OBJECTIVE:

ACTION: Ad the completion of this lesson, you will be able to describe POS, BPWRS, IMP, and the activities involved in planning the IMP and their responsibilities.

CONDITIONS: Use a DOD 4140.25-M to review the management of POS and BPWRS.

STANDARDS: Describe POS, BPWRS, IMP, and the activities that plan the IMP and their responsibilities IAW DOD 4140.25-M.

REFERENCES: DOD Manual 4140.25-M and AR 710-2.

INTRODUCTION

As a petroleum manager, your duties will require supervising, reviewing, and preparing the documents needed to identify the quantities of petroleum products required to be on hand by location to meet war plans. During this block of instruction, we will discuss how petroleum products needed to meet war contingency are computed and who reviews documents used to position stocks.

1. Tank Space Allocation. The tankage available at a DESP is totaled by type of product held, (for example, ten 10,000 bbl tanks total 100,000 bbl of space for JP8). This total space is then divided into four areas: vapor space, POS, BPWRS, and unobtainable inventory.

a. Vapor space is the top 5 percent total space available. This allows for fuel expansion and vapors.

b. POS consists of operating level and safety level.

c. BPWRS.

d. Unobtainable/unusable inventory is the portion of the inventory needed to prime the storage/distribution systems. It consists of pipeline fill, manifold inventory, and tank bottom below the suction line. The inventory is not available to meet day-to-day operations.

2. Petroleum Stocks at DESPs. They fall into two distinct categories: the POS and BPWRS.

a. Peacetime Operating Stock. POS is the amount of fuel required to sustain peacetime operations in support of military demands to be maintained at a DESP. If additional storage space is available, DESC may direct, on exception or emergency basis, additional POS be stored at a DESP for short periods of time.

(1) The POS is broken down into the operating level and the safety level.

(a) The operating level supports the day-to-day operations requirements.

(b) The SL is used to maintain operations when normal resupply is interrupted. The purpose of the SL is to protect DESPs from stock outages where no BPWRS are held or to provide a confidence level that at least 85 percent of a specific location's authorized BPWRS levels are available. BPWRS will generally serve as the safety level. In unusual conditions, DESC may authorize augmented safety level stocks in addition to the SL, (for example, at certain times of the year, the DESP could not be resupplied).

(2) POS is computed annually by DESC-O for all DESPs in coordination with DERs/SCPs/CINC-JPOs.

3. Bulk Petroleum War Reserve Stock.

a. BPWRS are stocks that are held as part of the BPWRR. The BPWRR is based upon the contingency OPLAN for that area as developed by the Joint Chiefs of Staff. BPWRS is positioned as close to the area of use as possible; however, it is subject to the storage/funds availability and BPWRS less than 150 barrels may not be practical to stock. BPWRS is in addition to POS. BPWRS in CONUS must be directly supporting an OPLAN. In OCONUS, BPWRS is to support military operations in a CINCs theater and cannot fall below the minimum needs sets up in common for NATO.

b. DESP stocks can be stored on land or on ships. When the stocks are stored on ships, the term "Afloat pre-positioning force" is assigned. The ships become floating DESPs and the stocks on board are held in support of BPWRR. DESC maintains accountability of APF stocks and they are used as necessary by the Unified Command to which they are assigned. APF stocks are not solely used to refuel ships. The Military Sealift Command provides ships and operating support under two categories:

(1) Maritime Pre-Positioning (MPS) - Which handles routine replenishment of stocks.

(2) Pre-Positioning Ships (REPO)- used for contingency operations.

4. IMP. The IMP is classified SECRET, based on the premise that divulging IMP data would seriously damage the ability of the United States to wage war or to defend itself. The IMP, related papers, and documents, will be declassified only at the direction of Office of the Deputy Undersecretary of Defense (Logistics). The IMP is developed and issued annually by DESC-O in coordination with CINC-JPOs. The IMP states required inventory levels and gives detailed inventory/storage data for DESPs in support of POS and BPWRS. DESC-O issues changes to the IMP by message, single pages, or complete document.

a. Maximum Stockage Levels. The sum of POS and BPWRS equals the maximum authorized inventory level. DESPs cannot exceed the IMP levels. If conditions dictate, the DESC-O may issue a waiver to or direct the DESPs to exceed the IMP level. DERs must monitor region levels to prevent overstockage on a regional basis and prevent malpositioning.

b. Inviolate Levels. A DESP inviolate level is 85 percent of the BPWRS plus the unobtainable inventory in tank bottoms, manifolds, and pipelines. Any consumption of a DESP's inviolate level exceeding 72 hours must be reported to the supposing DERs/DFPs/SCPs/SAPOs/CINC-JPOs/ DESC-O.

5. Responsibilities.

a. Join Staff/J4. It sets up pre-positioning objectives for regions and areas worldwide in the form of geographic days of supply. These objectives consider such factors as wartime tanker sailing times, in theater distribution times, attrition factors, and safety levels.

b. DESC. The DESC:

(1) Consolidate military service requirements for storage at DESPs and assigns maximum and minimum levels in the IMP.

(2) Develops and distributes the IMP in coordination with JPOs and military services.

(3) Plans for emergency shipments of BPWRS in CONUS.

(4) Recommends storage programs designed to provide balanced BPWRS level at DESPs.

EXAMPLE:

For the Army, his process starts at DA, DCSOPS. The USAPC receives a force list from each Unified Command. For the Navy/Marines, a list is passed to the NAVPETOFF; and for the USAF, the list is passed to Det 29. USAPC converts the force lists to fuel requirements based on equipment usage rates and the days of supply guidance from JCS. The data generated gets entered on DD Form 1887, "BPWRS for Terminal Storage." USAPC distributes the DD Form 1887 to the Army component of Unified Commands; for example, for Europe, the DD Form 1887 is sent to 200th TAMMC.

6. CINC-JPOs.

a. There is one JPO for each Unified Command:

(1) Atlantic Command; headquarters located at Norfolk, VA, is responsible for the Atlantic Ocean, Greenland, Iceland, and numerous smaller islands.

(2) Southern Command; headquarters located in Panama, is responsible for Central and South America.

(3) Central Command; headquarters located at MacDill AFB, FL, is responsible for 19 countries in Northeast Africa and Middle East.

(4) European Command; headquarters located at Stuttgart, GE, is responsible for Europe, Israel, and the majority of Africa.

(5) Pacific Command; headquarters located at Pearl Harbor, HI, is responsible for the Pacific and Indian Ocean, Japan, Korea, and Thailand.

b. JPO duties are:

(1) Coordinate and reconcile IMP data prepared by the military services for overseas location before sending DD Form 1887 to DESC-O.

(2) Monitor overseas theater and DESP inventories and notify J4 and DESC-O when inviolate levels are breached.

(3) Coordinate regional data in their area for inclusion in the IMP.

7. Military Services.

a. Compute BPWRR by location and product for the DOS as set by the JCS.

b. Inform DER/JPO/SAPO/SCP when inventory drops below inviolate levels.

c. Advise JPO when the required amount of POS/BPWRS cannot be held in GOGO facilities.

d. Notify JPO of any action that affects the availability of storage tank space; for example, repairs on tanks, conversion m one product to another, new tanks being brought on line.

e. CONUS - compile regional data for inclusion in the IMP.

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LESSON 4

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What does the POS sustain?

   A. Hostile operations
   B. Field training operations
   C. Peacetime operations
   D. Battalion evaluations exercises

2. Of what does the POS?

   A. Training operations and budget
   B. Operating level, detached units and host nation support
   C. Host nation support, budgeting, and training
   D. Operating level, safety level, and sometimes augmented safety level

LESSON 4

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	C. Peacetime operations (page 4-2, para 2a).
2.	D. Operating level, safety level, and sometimes augmented safety level. (page 4-2, para 2a(1)(a), (b)).

LESSON 5

MOVEMENT AND RESUPPLY

Critical Tasks: 03-5103.00-0087
03-5103.00-0082

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn the importance of moving petroleum bulk supply products and the responsibilities associated with ordering them.

TERMINAL LEARNING OBJECTIVE:

ACTION: As the petroleum officer, you will be responsible for identifying and describing procedures and responsibilities associated with the ordering and transporting bulk petroleum products with at least a 70 percent accuracy IAW DOD Manual 4140.25-M, Vol II, Ch 4 and 6.

CONDITIONS: Using the following lesson plan and DOD Manual 4140.25-M.

STANDARDS: Describe the various aspects of movement and resupply IAW DOD Manual 4140.25-M.

REFERENCES: DOD 414025-M, Vol II.

INTRODUCTION

As a petroleum officer, you may be assigned to a Joint Petroleum Office. You must be familiar with the concepts in movement and resupply of petroleum products to be effective in your job.

1. Resupply.

a. Distribution Plan. DPs are prepared by the DESC-O to advise DERs of contract sources (refineries) and DESPs scheduled to receive/ship fuel. CLINs in DPs indicate the quantity contracted in support of each DESP, contractor name, contract information, and mode of delivery. In overseas areas with a military distribution system the DP only shows the source of supply for the coastal DESP and not the base level DESPs.

b. Distribution Plan Authorization.

(1) DPAs are generated and distributed DFAMS based on DESC indefinite quantity contracts. DPAs are structured by DER. DPA is used for product codes and to outline contract data, quantitative requirements, ordering limitations and the authorized boundaries used by DER to initiate SIOATHs.

(2) The DESC-O monitors contracts funded by DESC, prepares and controls orders for ocean-going tankers with fuel acceptance at FOB origin, unless delegated to the DER. FOB origin is when the government accepts the product at the source (refinery) and then provides the transportation to the user. DERs control all other shipments.

2. DPA Funding.

a. Funds are reserved, committed, and obligated in DFAMs to cover orders for petroleum from contractors. DPAs are initially funded at the minimum guaranteed price and amount. The actual amount may fluctuate. In the last quarter of the contract the DESC-O will add the remaining finds via an amendment.

b. DPAs may be amended to ensure adequate petroleum supply. If monthly liftings exceed projected monthly lifting by more than 10 percent the DESC-O must promptly reconcile the problems with DERs.

c. An automated control record, DPA Control Record, is generated by the DFAMS data bank. The DESC-O certifies DPA data.

3. Quantity Control.

DFAMS generated DPA and SIOATH control sheets, status reports, and contract status inquiries are used to monitor and control quantities on order. DFAMS ensures the total DPA dollar value and contract quantity are not exceeded. When necessary, DERs may request an increase in quantity from the DESC-O but must justify why. A DPA CLIN quantity may be increased if:

a. Another CLIN of the same contract and product is reduced by a quantity that offsets the increased dollar amount.

b. The increased quantity does not cause the total contract quantity or dollars to be exceeded.

c. The contractor agrees to overlift and underlift line items.

d. In emergencies and if normal procedures fail, the DERs may request an increase in quantity from the DESC-O. The DERs will include why an increase is needed. Such as:

(1) Increased consumption due to special exercises.

(2) Increased consumption due to emergencies, and natural disasters.

4. Firm Funded Contract Release Letter.

FFCRLs are used instead of DPAs for contracts or portions of contract that are firm funded (fixed price and quantity). The FFCRL is prepared by the DESC-O.

5. Source Identification ad Ordering Authorization.

The SIOATH is a supply document initiated and controlled by the DER/DESC-O. It identifies the supply sources (refineries and DESPs), contract quantitative limitations, fund data, and authorizes DERs or military bases to order/requisition petroleum. DERs may not exceed the quantitative limit set in the DPA or FFCRL. Units may not exceed ordering amounts listed in the SIOATH.

a. Preparing SIOATHs.

(1) SIOATHs with refineries as the direct source of supply to DESPs are generated by DFAMs. DERs may amend the SIOATH if necessary.

(2) SIOATHs that have intermediate DESPs as supply sources for base level DESPs are prepared by DERs IAW provision set by the DESC-O.

(3) SIOATHs are not prepared for overseas DESPs. JPOs and SAPOs notify customers of DESP and pipeline support.

(4) SIOATHs arrive at military base DESPs five working days before to the new ordering period or in time to meet the minimum advance notice of the contact

(5) SIOATHs will show the quantity of fuel to be imported.

b. Special SIOATHs.

(1) Urgent requirements. DERs may provide SIOATHs which allow bases to order fuel before the ordering period of new contracts.

(2) Nonappropriated units. SIOATHs cannot designate such nonappropriated units as the ordering or receiving location. The sponsoring military service will requisition petroleum for them.

c. Final SIOATHs. The DERs prepare and distribute the amended final SIOATHs, that reports the actual quantity delivered, within 45 days after the DPA/SIOATH terminates.

6. Requisitioning Fuel From Intermediate DESPs.

DERs will notify military base-level DESPs of designated supply sources via SIOATHs, with a copy to the supply source DESP.

7. Ordering Time.

Fuel will be scheduled in advance of required delivery dates (RDD) by the following criteria:

- Ocean tanker -- 20 days
- Barge and pipeline -- 15 days
- Tankcar/truck -- 2 days (48 hours)

8. Movement.

DESC/DERs provide bulk petroleum transportation services through arrangements with MTMC, MSC, and commercial carriers. Within CONUS, MTMC has delegated to DESC these functions: determining the most efficient method of transportation; distribution of traffic among various competing carriers; and authority to suspend carriers for unsatisfactory performance. Rates and routes for transportation modes (except ocean tankers) are obtained from MTMC-EA.

9. Routing Data.

a. In developing routing data, DERs take into account DESPs receiving capabilities and constraints to avert detention or demurrage charges. DESC will coordinate the possibility of adjusting or increasing receiving capabilities at specific sites with the goal of lowering overall costs to DOD.

b. DERs provide routing instructions to shippers such as refineries, pipelines, and shipments between base-level DESPs. DERs issue routing instructions to shippers for each mode of transportation by grade of fuel. Routing instructions are also IAW the route order issued by MTMC-EA. Shippers coordinate the transportation schedule for loading/shipping the fuel and shipping schedules with the receiving DESP. Military activities schedule delivery orders with the supplier IAW SIOATH instructions issued by the DERs.

10. Scheduling.

a. The Slate. The slate represents current and future requirements at ocean DESPs and plans for the tanker delivery. Slates are consolidated requirements developed by DESC for ocean tanker deliveries. The slating program is designed to provide timely resupply of fuel at minimum costs. Slates are reported by DERs and JPOs to DESC-O for developing cargo schedules in coordination with MSC.

b. The WAS. The WAS provides the JPO and SAPO with tanker arrival information. The WAS is sent out on the first Tuesday after the monthly slates have been processed. The WAS will reflect all cargoes destined to fill slated requirements at all terminals from the date the WAS is sent out through the last day of the five-month slating period. On all other Tuesdays, a WAS is sent out listing all deliveries scheduled for the next 60 days. Changes other than previously mentioned will be updated by message traffic. The JPOs will review all WAS and update message traffic.

11. Bills of Lading.

SFs 1103, are used to ship government-owned product. DERs provide GBLs to shippers.

a. **GBLs are controlled/accountable documents.**

b. Shippers prepare GBLs for FOB origin deliveries based on shipping and distribution instructions provided by DERs.

c. DERs-provide GBLs for military "base to base" shipments.

d. When GBLs are not available and shipment is urgent, CBL may be used. They will subsequently be converted to GBLs by the applicable DER. When GBL shipments are rejected or cannot be unloaded, the consignee will notify the appropriate DER for instructions. The DER, and the QAR if so required, will determine the course of action to be taken and will so advise the consignee.

12. Demurrage.

Demurrage is essentially overtime charges levied against the government by shippers due to delays in unloading government cargo. MSC pays all demurrage charges for ocean-going tankers; DESC pays all demurrage charges for other modes (tank trucks, tank cars, inland and coastal tankers, and barges). **Demurrage incurred due to lack of timely attention or other reasons attributed to the military services may be billed to the responsible activity.**

13. Loading and Receiving Capabilities.

Military locations will report shipping and receiving capabilities IAW Volume V of DOD 4140.25-M (for example, the RCS 506 report). Contractors (CONUS) with refinery or terminal shipping points will report their loading capabilities upon award of a DESC contract.

14. Pipelines (existing or proposed).

a. DESC coordinates all discussions and planning with relevant military services/commands. Data required to decide on pipeline construction include, but is not limited to command fuel usage projections for the next five years; a guarantee of land easement rights, coordinated with state, Federal, and local authorities; and carries interested in providing pipeline service.

b. Pipeline negotiations include three cost elements: transportation; storage; and any required associated services, such as quality surveillance or additive injection. DESC, in turn, will provide DERs with pipeline operating agreements for operating with pipeline carriers.

15. Barge Shipments.

a. CONUS. DERs will request rates and routings for all commercial barge shipments via coastal, inland, or intercoastal waterways from MTMC-EA. Shipments will generally be 2.1

million gallons or less. Oceangoing barges with a capacity of 2.1 million gallons or more will be arranged by MSC when DESC tanker scheduling requirements exceed the MSC-controlled fleet tanker capability.

b. Overseas. CINC-JPOs will designate an in-country U.S. military unit in each country to handle bulk petroleum shipments via military barge. DESC will arrange through MSC all commercial barge shipments from one port area to another (ocean transportation) and between MSC-controlled tankers and shore facilities (lightering).

16. Inland Transportation Overseas.

Transportation of bulk petroleum products within overseas theaters will be provided by the agency designated by the CINC JPOs IAW DOD Directive 4500.9, including inland transportation services for DLA-owned fuel to area DESPs and base-level DESPs. DESC pays for commercial transportation.

17. Military Sealift Command.

a. Tanker Requirements Forecast. DESC reports long-range forecasts of bulk fuel lift requirements to MSC. The annual forecast is required approximately five months before to the beginning of the fiscal year lift period. Both annul and five-year forecasts are developed. DESC correlates projected product requirements with future procurements to determine requirements that will likely require MSC tanker delivery and the most probable source areas of procurement in each case.

b. Slating Product. Slated bulk fuel requirements for ocean tanker deliveries are submitted to DESC via the CONUS/overseas bulk fuel slate. Cargo and vessel schedules are developed/coordinated by DESC and MSC; logistics units are notified of cargoes, arrivals, and departures.

18. Replenishment.

a. Underway Replenishment. This represents fleet oilers or MSC-controlled tankers refueling ship bunkers at sea. Bunkerage refers to fuel carried by ships for their own propulsion use only.

b. In-port replenishment. INREP represents MSC-controlled tankers refueling APF ship bunkers in-port.

19. Consolidated Cargo.

CONSOL represents MSC-controlled tankers supplying cargo fuel to fleet oilers at sea. There are three categories of CONSOLs.

a. Charger Log IV. This is an opportune CONSOL. This means the product/cargo was not scheduled but circumstances are such that the fleet oiler has the opportunity to use the MSC tanker. Fleet oilers rendezvous with an MSC tanker along the tanker's prearranged route. Transfer of the product must be prearranged/approved by DESC-OL DESC funds are used to pay for tanker diversions for 24 hours or less. If the diversion time is greater than 24 hours, then the Navy will pay the entire diversion cost to include the first 24 hours.

b. Scheduled CONSOL. This is a scheduled replenishment at sea. All or part of the MSC tanker load is to support U.S. Navy needs. Direct delivery of the fuel to the fleet saves the cost of fleet oilers having to make a round trip to the DESP, resupplying the DESP after fleet oilers

have drawn them down, and saves time and handling of the product. Scheduled CONSOLs must be requested through the DESC-O at least 20 days in advance of the CONSOL date. DESC and the Navy split the cost of the CONSOL when the tanker is on station for 72 hours or less. The Navy pays for all charges that exceed the 72 hours.

c. Emergency CONSOL. This is a requirement certified by the Navy to be a bona fide emergency which cannot be supplied in any other manner. Emergency CONSOLs may be scheduled with DESC provided they are approved by the Naval Petroleum Office. DESC funds transportation costs for emergency CONSOLs.

20. Shipment Notice.

Notice of product shipment varies in terms of what data are provided vis-à-vis mode of transportation. CONUS tanker, barge, and pipeline shipments with acceptance at FOB destination data are furnished by DERs to DESPs. For overseas shipments, DESC notifies the SAPO and unit commands of shipments slated overseas through the weekly tanker arrival schedule or direct message when shipments originate outside the SAPO area.

21. Receiving Documentation.

The DD Forms 250 and 250-1 are used as shipment and receipt documents. DD form 250 for is used for contractor shipments of DLA-owned fuel via overland transport or pipeline. The DD Form 250-1 is used for shipments and receipts of bulk fuel transported by ocean tankers or barges. DFAMS transactions are used to confirm shipments documented under DD Form 250. The DD 1348-7 is used to document DOD issues, returns, and sales (for example, shipments between the military services and DESP to DESP shipments) and issues to non-DOD units under bilateral agreements. Also, the DD Form 1149 may be used by Navy-operated DESPs to document issues to afloat and ashore units when the point of sale or issue is in the DESP complex.

22. Receipt Practices.

Specific practices for determining receipt quantities when the receipt is from a contact source will be outlined in the contract itself For receipts from a DESP, Volume II, Chapter 5 of DOD 4140.25-M has specific guidance, depending upon the mode of shipment. In general, for products being received with additives (such as FSII, those additives must be injected into the bulk product prior to base tankage receipt. Injection sources include intermediate DESPs, industry sources, and pipeline operators.

23. Shipping and Receipt Discrepancies.

When the mode-specific receipt determination and delivery acceptance practices outlined in DOD 4140.25-M are not followed, contact the DER. For quantity discrepancies, follow actions in Chapter 10 of DOD 4140.25-M. For quality discrepancies, promptly notify the QAR, the shipper, DER, and DESC, as appropriate and initiate an SF 361 or SF 368 with required additional documentation.

LESSON 5

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the potion involved.

1. What is a DP?

   A. Depot pumps
   B. Distribution pumps
   C. DSFP's depot fuel pumping facility
   D. A notice that advises DERs of contractor sources and DESP's shipping/receiving schedule

2. How are funds obligated for DPAs?

   A. In DFAMS
   B. At the unit budget meeting
   C. Through the Brigade S4
   D. There are not any obligated funds

3. What is an SIOATH?

   A. Another name for a weekly arrival schedule
   B. Identifies supply sources and quantity limitations and authorizes DERs and military bases to order petroleum
   C. A barge shipment
   D. A fuel receipt

LESSON 5

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. D. A notice that advises DERs of contractor sources and DESPs shipping/receiving schedule. (page 5-2, para 1a).

2. A. In DFAMS. (page 5-2, para 2a).

3. B. Identifies supply sources and quantity limitations and authorizes DERs and military bases to order petroleum. (page 5-3, para 5).

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LESSON 6

BULK PETROLEUM ACCOUNTABILITY

Critical Tasks: 03-5103.00-0087
01-5103.00-0003
01-5103.30-2045
03-5103.00-0024
03-5103.00-0096

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about bulk petroleum accountability and the DOD and civil agencies that support the fuel community.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify bulk petroleum accounting documents used by the Air Force, Army, Marine Corps, and Navy.

CONDITIONS: Given the corresponding lesson plan and references.

STANDARDS: IAW the listed references and corresponding lesson pan.

REFERENCES: AR 710-2, DA Pam 710-2-1, DA Pam 710-2-2, DOD Manual 4140.25-M, AFP 144-3, FMFM 4-18, NAVAIR 00-80T-109, CINCLANTFLTINST/CINCPACFLTFINST 4026.1, IAW AF Reg 20-14 and NAVSUP 588.

INTRODUCTION

The refueling of the armed forces is an ever-increasing requirement. The need for fuel quality and accountability is to ensure accurate controls of ownership over receipts, issues, and inventories.

1. Service Contract Requirements.

a. The DLA has overall responsibility for the management of all classes of supply to include petroleum for the DOD and civil agencies in the federal government worldwide.

(1) The DESC is the integrated materiel manager of bulk petroleum products for DOD and civil agencies of the federal government world-wide.

(2) The following military service agencies submit CONUS requirements for contracting, using DD Form 448.

(a) The United States Air Force San Antonio Air Logistics Center Kelly AFB, Texas.

(b) The United States Army Petroleum Center, New Cumberland Army Depot, New Cumberland, PA.

(c) The United States Marine Corps and Navy are handled through the Navy Petroleum Office colocated with Defense Fuel Support Center, Fort Belvior, VA.

(3) The Unified Command's PO and DFR submit their requirements to DESC in a monthly slate.

2. Contract Order Documentation.

a. The contract ordering authorizations for CONUS is Source Identification and Ordering Authorization (SIOATH) (DFSCH Form 21.1), which identifies supply sources, contract limitations and fund data to requisition.

b. The ordering office maintains SIOATH Control Record (DD Form 1886), which is used to report status of orders (for example, amount on order but undelivered).

c. The services order fuel from civilian contract and DESC stocks using the following documents:

(1) DD Form 1155. This Form is used to place orders for bulk fuels from a civilian contract source.

(2) DD Form 1348-1. This Form is used when ordering/receiving from a DESC terminal. (NOTE: DD Form 1348-1 is also used between military activities.)

(3) DD Form 250. This Form is used when shipments are by commercial rail, tank truck, or pipeline.

(4) DD Form 250-1. This Form is used when shipments are by waterborne delivery (ocean/coastal tanker and barge).

(5) DD Form 1149. This Form is used when shipments are from military facilities. (NOTE: DD Form 1348-1 is also used between military activities.)

3. Petroleum Accountability.

a. The Air Force's FMO is responsible for the base fuels inventory and accountability.

(1) All aircraft issues or sales are either cash or credit Authorized US Government, state, local aircraft, selected contract, charter and foreign military may purchase fuel from an air force source.

(2) Credit purchases are based on the receiving customer being authorized credit and possess a U.S. Government aircraft identaplate for charge.

(3) Authorized customers are:

(a) Department of Defense. Aircraft issued a fuel identaplate either DD Form 1896, DD Form 1897, or AF Form 1245.

(b) Non-Department of Defense. Contract, charter, civilian and foreign government aircraft identified in the public "CMA". (NOTE: "CMAL" is pronounced "CAMEL".)

b. The Air Force documents base credit issues of ground fuels by the issue of identaplates. Identaplate are issued by base transportation for vehicles and by the FMO for nonvehicle (for example, lawn mower, weed eater).

(1) AF Form 1252 or 1252A for vehicles.

(2) AF Form 1295 or 1295A for non-vehicles.

NOTE: AF Form 1252 and 1295A are used at automated service station.

NOTE: The identaplate remains with the equipment at all times.

4. Ground and Aviation Product Issues Documentation.

a. AF Form 1994: This Form is used for credit issues and defuels to DOD aircraft and equipment. Also serves to record nonautomated issues of ground fuel or oil to DOD and base-supported non-DOD customers.

b. AF Form 1995: This Form is for both credit issues and defuels and record cash sales (in conjunction with a Cash Collection Voucher) to non-DOD aircraft and equipment. For ground product transactions, it serves to document all unautomated, nonbase-supported issues to non-DOD customers.

c. DD Form 1131: This Form documents cash sales of aviation products. The money collected goes to the Base Accounting and Finance Office with copies of the DD Form 1131. The FMO keeps the original, together with a validated copy from Accounting and Finance in the FMO files.

5. Daily Management of the Inventory.

Account reconcile and balance of inventory is done every morning at 0800. This involves the use of many different Forms.

a. AF Form 791. Fuel issued to tanker aircraft are recorded on AF Form 1994 as a normal issue. Each issue to another aircraft in-flight is recorded by the tanker boom operator on AF Form 791. The AF Form 791 after completion of the refueling mission goes to the home station FMO. The FMO processes "issues" to those aircraft refueled in-flight and bills their parent organizations for the fuel received. The tanker organization then gets credit for the issues.

b. AF Form 824. This form is prepared daily by the FCC controller. The Form reflects all fuel servicing operations and events for a 24-hour period and is closed-out at 0800 each day. This Form is used to cross-check information on issue documents (AF Forms 1994 and 1995).

c. Computer Paper Tape. Is the automated service stations transactions record. This record is processed daily through the accounting section through the Fuels remote to the main Supply computer.

d. AF Form 1231. This is used to document receipts of a single grade of product over a 24-hour period. The accountants verify all receipts and supporting shipping documents and record the totals for later use on the AF Form 1237.

e. AF Form 1232. This form is in the shape of an envelope. It holds both the individual AF Forms 1994 and 1995 and serves as a summary sheet to consolidate and total the issues and defuels occurring during a specified period. When used with refueling units, it covers the period or cycle from the time of filling until the unit is refilled, or in the case of defuels, until the fuel goes back to bulk storage. When used with hosecarts, it consolidated issues and defuels for a single 24-hour period (usually 0800 - 0800). The accountants review for completeness and accuracy the supporting documents AF Forms 1994 and 1995. They then audit and consolidate all AF Form 1232 summaries and total issue and defuel figures for use later on the AF Form 1237.

f. AF Form 1233. This form is prepared daily by the bulk storage section for each grade of product handled. It shows all issues from (truck fills, shipments, and transfers) and defuels (returns) to bulk storage during a 24-hour period. The accountants review for accuracy and completeness and record the information for use on AF Form 1237.

g. AF Form 1234. This form is prepared at the start of the computer month for each grade of product dispensed by the units. The accountants total the in-service refueling unit inventories daily on this form. Information is later used on AF Form 1235. The AF Form 1234 lists all refueling units and their inventory and in-service/out-of-service status.

h. AF Form 1235. Bulk storage attendants gage all tanks daily as of 0800 (if weekly inventory procedures then as of 0800 Friday). The accountants consolidate and total tank quantities by grade, then make additional entries (for example, AF Form 1234 and pipeline inventory). The quantity represents the actual physical inventory of each grade of product stored and will also end up on the AF Form 1237.

i. AF Form 1237. This form is prepared at the beginning of the computer month for each grade of product managed. Daily data entries come from AF Form 1231 (receipts), AF Form 1232 and 1233 (issues), and physical inventories from AF Form 1235. The form 1237 reflects all fuels transactions for the previous 24-hour period. When the Form is filled out, it will give the book inventory for each grade of product for every day of the month.

6. Inventory Balancing.

The Air Force when balancing the account pays special attention to product gains and losses. Gains and losses fall into two categories: intransit and determinable.

a. Intransit gains or losses are variances in volume due to temperature changes experienced during movement of product from origin to destination. The gains and losses are found by comparing quantities received against quantities shipped after adjusting the receipt to 60°F. A variance of more than one-half percent (.005) is excessive and requires an investigation and explanation. The accounting section processes acceptable variances through the computer, adjusting the item record balance according to the amount of gain or loss.

b. Determinable losses result from a specific cause, such as pilferage, spills, line breaks, or fire. When reason for and corrective actions are taken to preclude recurrence of a determinable loss the accounting section drops the loss, from the item record a special inventory adjustment is processed and the records and are adjusted.

7. Army Accounting System.

a. Army fuel accounting is managed under two levels. They are:

(1) Direct and General Support System. Accounting is managed at the DS/GS units and Installation level by stock record accounting for receipts, issues, and inventories by the SSA.

(2) Customer Using Unit Level. This requires documentation for audit train.

b. The SSA level documents are used to order, receipt issue, inventory, and adjust the account. The Forms used are:

(1) Stock Record Accounting -

DA Form 272 -- This form is used to list request for fuel and their status. Also listed DA Form 3644 and 4702-R.

(2) Army (SSA) Accounting -

(a) DA Form 1296 -- For each product and grade, there will be a separate card.

(b) DA Form 2765-1 and DD Form 1348-1 -- Used to order and receipt for product.

NOTE: All gross gallons that equal or exceed 3,500 gallons must be volume corrected to 60° F to permit net quantity (gallons) to be determined for each delivery.

(c) DA Form 3643 -- Identifies equipment, fuel type and quantity, receiving unit, and signature. The Form normally is used for one product and covers one day. The Form is a supporting document to a daily quantity listed on DA Form 3644.

(d) DA Form 3644 -- The quantity total each day by product type is abstracted from the DA Form 3643s onto the DA Form 3644.

(e) DA Form 3853-1 -- Used to record gaged quantity in a storage container. Is used to support quantity on-hand inventory, opening and the closing will be recorded in the remarks column.

(f) DA Form 4702-R -- Used to record inventory quantities, opening, receipts, issues, balance, gains, losses, and adjustment to DA Form 1296.

8. Army Customer Using Unit Accounting.

a. Unit commanders will designate in writing a responsible individual to maintain control of bulk fuels and provide an audit trail using these forms:

(1) DA Form 2064: is used for posting and controlling documents.

(2) DA Form 2765-1 and DD Form 1348-1; are used to order and receipt for product.

(3) DA Form 3643 and DA Form 3644 -- bulk petroleum receipt will be assigned a document number from the document register. Upon receipt, the document will be posted in column "a" and the quantity recorded in the receipt column of the DA Form 3643. Retail issues and defuel receipts will be recorded in the respective column on the DA Form 3643. The issue and receipt columns will be totaled and posted daily on the DA Form 3644.

(4) DA Form 3853-1:

(a) Daily: Tanks that have either issues or receipts will be inventoried and data will be recorded on DA Form 3853-1, or locally authorized Form.

NOTE: Volume correction of daily inventories will be accomplished on measured volumes that exceed 3,500 gallons.

(b) Weekly: Tanks that do not have issues or receipts will be inventoried at least once a week. The physical inventory data will be reconciled by comparing with the previous inventory data to detect any variances.

(c) Monthly: A physical inventory of Army-owned bulk petroleum will be performed for each type or grade of product. The inventory will reflect the quantity on hand as of (0800) the last day of each month. DA Form 3853-1 or local form will be used to record inventory data. The inventory will include the totals for each type or grade of product within the account, and includes both above and below ground tank, trucks, and any other fuel-containing items.

(5) DA Form 4702-R: -- end-of-month inventory will be summarized by using DA Form 4702-R.

b. Authorized Loss or Gain Allowances.

(1) Some losses or gains are to be expected when handling and storing volatile products. Allowable loss and gain percentages prescribed in the regulation are considered sufficient to accommodate expected normal product losses and gains.

(a) Handling loss or gain of jet fuels, AVGAS, all gasolines, and all other products are allowable up to the extent of the actual loss or gain allowances.

1 Losses or gains for jet fuels, AVGAS, and gasoline must not exceed a plus (+) or minus (-) 1 percent of the total of the opening inventory plus the receipts for the monthly period covered by the MBAS.

2 Losses or gains for all other petroleum products must not exceed a plus (+) or minus (-) 1/2 of 1 percent of the total of the opening inventory plus the receipt on the MBPAS.

(b) The total loss of a specific bulk petroleum product may be less than the loss allowance for that product.

1 Only the actual loss is allowable.

2 Actual losses exceeding the stated allowance and the entire loss has a monetary value o $500, a report of survey is required.

3 Actual losses exceeding the allowable, but having a total monetary value less than $500, a causative research will be initiated and attached to the MBPAS as a supporting document.

(c) The total gain of a specific bulk petroleum product may be less than the authorized gain allowance for that product.

1 Only the actual gain is posted to the accountable records.

2 Gains above the allowable limits will be investigated to determine cause. A copy of the investigation will be attached as a supporting document to the MBPAS.

(d) Adjustment of accountable records.

1 Spillage and/or contamination losses will be documented by the responsible individual for quantities over 25 gallons. The documentation will be attached to the MBPAS as a supporting document to adjust records.

2 The MBPAS used to reflect the on-hand inventory will be completed within three working days and forwarded to the approving authority, who may disapprove any item on the MBPAS.

a If the approving authority disapproves any loss, the initiation of a Report of Survey is required.

b If the approving authority disapproves any gain, an AR 15-6 investigation is required.

3 The MBPAS, with all supporting documents (receipts, issues, inventory, report of survey, and AR 15-6) will be retained in an active file for one year and in an inactive file for two years. These documents will be filed per AR 25-400-2.

9. Marine Corps Accounting.

Daily status reports, daily fuel issue reports, and monthly bulk fuel accounting summaries are used to maintain accountability of bulk fuel receipts, issues, and stocks on hand.

a. Daily Status Reports - used to determine allocation adjustments and maintain support. The report is prepared by the bulk fuel supply poi and submitted to its higher headquarters. The daily status report may be informal and only identify receipts totals by product (ground fuels are identified as: - Green $ and Air - Blue $, with total quantity to date).

b. Daily Fuels Issue Reports - used to identify issues and receipts to equipment and amounts delivered and picked-up. The report can be an official logbook or a single report.

c. Monthly Bulk Fuel Accounting Summary - identifies inventory totals opening, receipts, issues, gains, losses, and adjustments.

10. Navy Accounting.

The navy DBOF owns the petroleum “retail stocks.” Retail stocks include fleet oiler's, inventories and, aviation and ground/heating fuels.

a. Documents such as DD Forms 1155, 250, 250-1, 1348, and 1348-1 are examples of Forms used for fuel accounting.

b. NAVSUP Form 766: list receipts, issues, and account adjustments.

c. Monthly Physical Inventories: summary of receipt and issue actions.

d. NAVAIR. (Reports) “Direct Refueling Station Log” and “Aircraft Refueling Dispatch Log”, these reports identify issued quantities.

e. Fuel Afloat: “DD Form 1149” is used by the ship's supply department to request and receipt for supplies.

LESSON 6

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. Which Form is used to place orders for bulk fuels from a civilian contract source?

   A. DD Form 1555
   B. DA Form 1155
   C. DD Form 1155
   D. DD Form 1149

2. Is the fuel identaplate ever removed?

   A. No.
   B. Yes.

3. The Navy uses which of the following Forms for fuel accounting?

   A. DA Form 2022, DD Form 1155, DD Form 25-1, DD Form 1348-1, and NAVSUP Form 766
   B. DA Form 2024, DD Form 1555, DD Form 25-1, DD Form 1348-1, and NAVSUP Form 766
   C. DD Form 1155, DD Form 250, DD Form 250-1, DD Form 1348, DD Form 1348-1, and NAVSUP Form 766
   D. DA Form 2024, DD Form 1155, DD Form 252-1, DD Form 1348-1, and NAVSUP Form 676

LESSON 6

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. C. DD Form 1155 (page 6-2, para 2c(1)).

2. A. No, (page 6-3, para 3b, note).

3. C. DD Form 1155, DD Form 250, DD Form 250-1, DD Form 1348, DD Form 1348-1 and NAVSUP Form 766, (page 6-8, para 10b and c).

LESSON 7

PETROLEUM OPERATING REPORTS

Critical Tasks: 01-5103.30-2103
01-5103.00-0024
01-5103.00-0076
01-5103.00-0091
01-5103.00-0098

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about petroleum equipment and facility status. You will also learn how to prepare or supervise the preparation of reports submitted by the terminals at headquarters staff IAW DOD and Army directives.

TERMINAL LEARNING OBJECTIVE:

ACTION: Various terminal operating reports and their uses.

CONDITIONS: Given DOD 4140.25-M and DA Pam 710-2-2.

STANDARDS: Describe the terminal operating reports IAW the corresponding lesson plan and listed references.

REFERENCES: DOD 4140.25-M, DA Pam 710-2-2, and AR 710-2.

INTRODUCTION

Terminal operating reports are necessary in determining and verifying quantities of petroleum products on hand, received, and issued by location as well as equipment and facility status. During this block of instruction, we will discuss various types of reports that are used and required by higher-headquarters to provide a status of location and facilities.

1. Bulk Petroleum Storage Facilities Report (RCS 506).

NOTE: Reference DOD 4140.24-M, Vol II, page 8-6, and DA Pam 710-2-2, page 287.

a. DESC controls, maintains, and publishes the RCS 506 report which documents military, federal, or civilian contacted bulk petroleum storage facilities of 500 barrels of more capacity

and/or banks of smaller tanks manifolded together which have a total capacity of 500 barrels or more for a single product. This report provides a data base for analyzing storage capabilities and associated petroleum products worldwide in support of both the peacetime and contingency bulk petroleum mission. The report is issued annually on 1 October.

b. Changes in bulk petroleum storage facilities must be reported, as they occur, when there is a change in:

(1) Storage capacity, including product allocation.

(2) Berthing capacities that affect the size of tanker or barge that can be accommodated.

(3) Shipping or receiving facilities increases or decreases.

c. Changes are inputted directly into DFAMS by DESPs/DERs except for classified data. Classified data are done on worksheets that are mailed to DESC-F.

d. There are six sections to the RCS 506 report:

(1) Section I - Activity Information. Includes command, location, and operating hours.

(2) Section II - Tankage Information. Includes products, number of tanks by product, shell capacity in barrels, tank characteristics (type of construction, protection) tanks in/out of service and owner.

(3) Section III - Manifold Information. Includes products codes, and capacity.

(4) Section IV -Vessel Berth Information. Includes type, draft, size, channel and tonnage for type of vessels that can load/unload at the facility.

(5) Section V - Receipt and Issue Capability Information. Includes data on products and hourly pumping rate for issuing and receiving for each method of delivery/receipt (tanker, barge, rail, pipeline, and truck).

(6) Section VI - Bulk Petroleum Storage Review Planning Data. Includes information on all changes, construction, repair, and additions.

2. Bulk Petroleum Storage Facilities Report (RCS 830) (DA Form 541 1-R).

NOTE: Reference DA Pam 710-2-2, page 237.

a. This report is submitted by CONUS Army commanders to USAPC upon request. The report provides data on fixed petroleum storage facilities with individual or manifold configured tankage ranging from 200 to 21,000 gallons.

b. This report coupled with the RCS 506 report (which reflects quantities greater than 500 barrels (21,000 gallons) and greater) allows USAPC to determine the total CONUS petroleum storage capacity.

3. Bulk Petroleum Terminal Message Report (RCS: DLA (W) 1884) MIN.

NOTE: Reference DOD 4140.25-M, Vol I Ch 10, page 10-13, and DA Pam 710-2-2, page 237.

a. This is a weekly operational report submitted by each CONUS and designated OCONUS DERs on each DESP that has DLA-owned products. The report provides quantitative data for DESC inventory management and stock control/distribution of bulk fuel.

b. The report is prepared 0800 on Friday and submitted via EDI. The report must arrive no later than 0800 the next Monday at Washington, D.C.

4. Pre-Positioned War Reserve Requirements for Terminal Storage (RCS 1887).

NOTE: Reference DA Pam 710-2-2, page 237.

NOTE: PWRR/S is the old term BPWRR/S is the new term.

a. For the Army, USPAC computes the BPWRlR by grade of product based on approved force structure. For sister services, the requirement is calculated by their petroleum agency (for example, NAVPET for Navy). The Army stores the BPWRR at or near the location of ultimate use.

b. USPAC provides theater army commands a partially completed DD Form 1887. The Theater Army staff agencies complete the forms, coordinate with the JPO and return the forms to USAPC. USAPC then consolidates all information and forwards terminal storage requirements to DESC for inclusion in the IMP.

c. The IMP is a two-volume publication that provides data on storage availability and product inventory which is to be positioned geographically in support of peacetime operations and bulk petroleum war reserve material requirements. As requirements and force structure change, the inventory of petroleum to support the force changes.

5. Source Identification and Ordering Authorization Control Record (DD Form 1886).

NOTE: Reference DOD 4140.25-M, Vol II, Ch 4, page 4-3, and DA Pam 710-2-2, page 237.

a. Army activities that receive SIOATHs to order products from an industry source are required to submit an on order but undelivered report, the DD Form 1886, each month. DFRs maintain a DD Form 1886 for each CLIN in the SIOATH.

b. Computer-generated records, that provide daily status of each order with actual and projected balances, may be used in lieu of DD Form 1887.

6. Bulk Petroleum Capability Report.

NOTE: Reference DOD 4140.25-M, Vol II, Ch 13, page 13-3.

a. POLCAP reports provide the joint staff, military services, and DLA with current petroleum data to ensure that essential petroleum operations and readiness capability are maintained during periods of intensified activity or tension.

b. Theater commands submit POLCAPs annually, no later than 1 May, to the joint staff During intensified activity, the joint staff may ask CINCs to update POLCAPs by message.

c. POLCAP information includes: Any changes since the last report; product availability and sustainability; any problems deemed appropriate; data requested.

7. Bulk Petroleum Contingency Report.

NOTE: Reference DOD 4140.25-M, Vol 1, Ch 13, page 13-3.

a. REPOLs provide the joint staff military services, and DLA/DESC worldwide on damage and deficiencies of bulk petroleum supplies, storage and distribution systems. REPOLs are used to develop strategies, and determine courses of action, in support of supply operations.

b. OCONUS Theater Commanders and DESC, for CONUS DERs, submit to the joint staff. REPOLs are submitted as follows:

(1) Automatically upon declaration of DEFCON 1 and every 48 hours thereafter.

(2) Under peacetime conditions, twice a year, 30 March and 30 September.

(3) When considered appropriate by reporting commanders or when directed by the joint staff

LESSON 7

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What report provides data on all storage of bulk petroleum 21,000 gallons and greater?

   A. Fuel report DA Pam 710
   B. Bulk fuel DA Form 2024
   C. Bulk Petroleum Facilities Report (RCS 506)
   D. Fuel DD Form 1609

2. What report is submitted weekly as of 0800 each Friday?

   A. Bulk Petroleum Terminal Message Report (RCS 1884)
   B. Bulk Petroleum Terminal Message Report (RCS 1889)
   C. Bulk Petroleum Terminal Message Report (RCS 1887)
   D. Bulk Petroleum Terminal Message Report (RCS 506)

3. What report is sent upon declaration of DEFCON 1?

   A. Bulk Petroleum Contingency Report
   B. Bulk Petroleum Capability Report

LESSON 7

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	C. Bulk Petroleum Storage Facilities Report (RCS 506). (page 7-2).
2.	A. Bulk Petroleum Terminal Message Report (RCS 1884). (page 7-3).
3.	A. Bulk Petroleum Contingency Report. (page 7-4).

LESSON 8

AUTOMATED FUELS ACCOUNTABILITY

Critical Tasks: 03-5103.00-0087
03-5103.00-0098
03-5103.00-0076
03-5103.00-0024
01-5103.30-2123

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about using the appropriate fuel reporting procedures.

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe the system, purpose, origins and management of FAMS, transaction reporting, and monthly reconciliation.

CONDITIONS: IAW this corresponding lesson plan.

STANDARDS: Describe the terminal operating reports IAW the corresponding lesson plan.

REFERENCES: None.

INTRODUCTION

This lesson of instruction will familiarize you with the various uses of compute technology in dealing with petroleum distribution and its accountability procedures.

1. Purpose of DFAMS.

Timely DFAMS reporting produces up-to-date information that accurately reflects current conditions worldwide by theater or specific location. This permits DESC or military managers to make timely and well-informed decisions on:

a. Stock positioning in response to changes in demand, possibly by diversion of petroleum already in route.

b. Managing financial transaction to ensure optimum use of funds available and to avoid imbalances.

c. Routine stock replenishment. DESC and DERs must know when to ship product to what locations, and in what quantities.

d. DESC accounting and financing receives documentation confirming what payments are owed to commercial suppliers for fuel accepted into the system and when to target payments to get any discounts.

e. The DESC comptroller uses DFAMS data base as the basis for billing the military services.

f. DESC must account for all fuel it owns worldwide and at all locations, including both inventory and financial accountability. This means keeping track of about 92 million barrels of petroleum, valued at more than $4 billion, at any given time. DFAMS keeps inventory and financial accounts current with more than 100,000 transaction occurring each year. These records are reconciled periodically with amounts actually on hand. DFAMS is certified by the General Accounting Office as meeting the standards for government accounting.

2. Origins of DFAMS.

a. Prior to 1971, DLA's mission was only the procurement of bulk petroleum. In August of 1971, the Deputy Secretary of Defense expanded the mission of DLA from only procurement to worldwide centralized and integrated supply management responsibility for all bulk fuel required by the military services. This mission is referred to as IMM.

b. The objective of fuel IMM is to achieve timely worldwide inventory management control and to establish financial control of DESC inventories. Bulk fuel IMM includes procuring the product form commercial suppliers, assuming ownership and accountability, financial and inventory management and storage, safeguarding and distribution to the point of delivery to base boundary, and sale to military service. The complex and interrelated new responsibilities demanded a fast, accurate, and integrated management information system. However, no system existed that matched the integrated functions required for bulk fuel management.

c. Existing systems designed for the individual functions in the services were used but they were not compatible; there was no common language and no single unified point of data entry. In 1975, DFAMS was conceived as the response to a need. DOD approved the concept and design work began in 1976 by DESC. To assure compatibility of fuels automated systems with other DOD logistics systems, common codes and formats were prescribed through a standardized reporting system known as DOD MILSPETS.

d. MILSPETS prescribes DOD standard forms, codes, data elements, formats, and related instructions to document fuel transactions, provide product accountability/audit trail, and report/record transactions for DFAMS. Where possible, codes and forms common to other DOD military service systems are used, such as MILSTRIP and MILSTRAP. Each service has a representative on the MILSPETS committee. Through these representatives, each service approves and coordinates any new programs requiring service participation.

e. After extensive systems design work and interservice coordination, DFAMS began operating in October 1982.

3. DFAMS System Description.

a. Central to DFAMS is its computer-stored integrated data base which includes information files on:

(1) Procurement Contract Status. Information pertaining to DESC contracts for bulk petroleum and additives.

(2) Transportation Management. Information concerning military and commercial tankers, commercial pipelines, truck movements, and other modes of transportation.

(3) Inventory Management. Provides stock control for each product at every terminal and pipeline holding DLA-owned stock.

(4) Financial Information. Information on all accounts relating to DLA/DESC stocks.

NOTE: Any entry into the data base simultaneously updates all applicable files.

b. Data entries are made into the data base from:

(1) DESC. DESC conducts transactions for orders against bulk fuel contracts, reporting MSC tanker shipments, management of some special inventory accounts such as floating storage and issuance of DPAs and SIOATHs for tankers and overseas commanders.

(2) DFAMS. Reporting activities report all transactions that affect the stock status or ownership of bulk fuel in the DESC wholesale system.

4. Transaction Reporting.

a. A transaction is any decision or action, such as an order, receipt, or shipment, which affects ownership or inventory status of DLA-owned bulk fuel. The reporting of transactions is the chief way in which the DFAMS data base is kept current with the many events involved in supplying fuel to the military services. Transaction reporting begins where the decision or action occurs. There are over 200 DESPs that receive and store fuel.

When an action is physically complete, the DESPs must forward the information about the transaction within two working days to a DFAMS data entry point.

b. There are 45 DFAMS entry points (outside DESC):

- 10 Defense Energy Regions
- 10 Defense Intermediate Control Points operated by the military services
- 25 Defense Energy Support Points

NOTE: Of these 45 data entry points, 15 are located CONUS and 30 are OCONUS. Some data entry points have access to the DFAMS data base by remote terminals, but some use Autodin mode for transmitting their transaction reports to DESC.

c. The last segment of the DFAMS transaction reporting network is the military bases. The military bases must report their orders and receipts of DESC-owned petroleum to complete the accountability cycle and balance their accounts.

d. Timely and accurate reporting is essential to DFAMS and the military services. Fuel supply conditions change continually and rapidly. The sooner the transaction is reported to the data base the more accurate the data base picture of what is happening NOW! DOD Manual 4140.25-M sets that standard of two working days and 95 percent accuracy. The availability of up-to-date information permits better decisions and actions by managers at all levels.

5. Monthly Reconciliation.

a. Reconciliation is required to meet GAO standards and to safeguard against unacceptable losses. Reconciliation also verifies the DFAMS data base.

b. The reconciliation process requires that two figures be compared at the end of each month, both represent a specific product at a specific location. These two figures are the findings of a physical inventory, the amount actually on hand, and the book inventory stored in the DFAMS data base. If the two figures agree, the accounts are reconciled; the amount in the DFAMS data base has been verified. If the two figures do not agree, the difference must be researched and accounted for. The difference may be a gain or loss.

c. Reconciliation gives assurance that the physical stocks are secure at the terminals and that the records in the DFAMs data base are correct. The goal of DESC is to have all accounts reconciled by the sixth calendar day of each month.

6. Fuels Automated Management System.

The Air Force uses: the Air Force Accountability System. The system is maintained at base level. The base fuel operation can account for all fuel distribution down to the tail number of the aircraft in which the fuel was dispensed too. This system is currently under revision and will be combined with DFAMS, the resulting system will become the FAS.

7. Management of DFAMS.

a. The Directorate of Supply Operations (DESC-O) has the key role for DFAMS transaction reporting and related applications. Several other organizations are involved in varying degrees. They are:

(1) Office of Telecommunications and Information Systems (DESC-S). DESC-S is responsible for the telecommunication and electron processing systems and equipment. DFAMs relies heavily on telecommunications and teleprocessing. DESC-S has the major responsibility for DFAMS long-range planning, systems and concept formulation, system design and acquisition, operational implementation, and progressive system improvements.

(2) All DESC Users of DFAMS Data. Principal users of DFAMS information products include the Comptroller (DESC-C), the Accounting and Finance Division (DESC-CD), the Directorate of Contracting and Production (DESC-P), the Stock Control Division (DESC-OC), and the Inventory Management Division (DESC-OD). These principal users of DFAMS information contribute to the development of DFAMS applications and participate in changes to the system which affect their needs.

(3) MILSPETS Administration. MILSPETS is involved in the coordination of all DFAMS development or changes that affect the military services. Since DFAMS is a DOD-wide system, all DFAMS system developments or changes must have MILSPETS coordination. This gives the military services representation on development and changes to the system.

(4) Defense Energy Regions. DERs participate in DFAMS development and refinement. The DERs often suggest improvements to the system based on their field operating experience. DESC may arrange to have one or more regions pilot and evaluate system changes before they are adopted system wide.

8. Responsibilities Within Directorate of Supply Operations (DESC-O).

a. System Development and Improvements (DESC-OB). DESC-OB works within approved program development plans and initiates improvements in the DFAMS system and coordinates them with other activities. DESC-OB is the DESC representative on the MILSPETS committee.

b. Performance Evaluation and Operating Assistance to DFAMS Reporting Activities (DESC-OC). DESC-OC has the responsibility of day-to-day surveillance of DFAMS reporting and end-of-month reconciliation worldwide. This involves continuous monitoring of daily transaction registers, suspense listings, and reject notices. DESC-OC is responsible for answering inquiries or requests for procedural guidance from reporting activities. DESC-OC will prepare and distribute to reporting activities a summary statement indicating their average time required to report transactions, their error rate, and their date of achieving reconciliation. This is done to provide feedback to and establish communication with reporting activities with the goal of improving performance IAW with system-wide objectives.

c. Assistance in Obtaining Management Information From DFAMS. DESC-OB is responsible for assisting managers at DESC, DERs, JPOs, and military services in obtaining non-routine or special information from the DFAMS data base. DESC-OB is responsible for developing and administering a training program in support of DFAMS operations. This includes the development, maintenance, and distribution of suitable materials. DESC-OB will arrange the training as the need arises at DESC-managed activities including DERs, DESPs, and for QSRs and QARs.

LESSON 8

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answer with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What is the purpose of DFAMS?

A. To process fuel receipts
B. To keep the Brigade commander satisfied
C. To pay accounts receivable
D. To provide information for making timely decisions on petroleum stock positioning, financial transactions, routine stock replenishment, payments, and billing

2. What does MILSPETS do?

A. Data entries made on the fuel report
B. Fuel issuing procedures
C. Prescribes standard forms, codes, data elements, format, and instructions to ensure DOD- wide system compatibility
D. Military fuel specifications

3. What is the DESC goal for monthly reconciliation?

A. To have all accounts reconciled by the sixth of each month
B. To have all accounts reconciled by the 15th of each month
C. To have all books cleared no later then the end of each month
D. To not have to conduct one

LESSON 8

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. D. To provide information for making timely decisions on petroleum stock positioning, financial transactions, routine stock replenishment, payments, and billing. (page 8-2, para 1).

2. C. Prescribes standard forms, codes, data elements, format and instruction to ensure DOD wide system compatibility. (page 8-3, para 2d).

3. A. To have all accounts by the sixth of each month. (page 8-5, para 5c).

LESSON 9

SPILL CONTROL

Critical Tasks: 01-5103.30-2103
01-5103.30-2120
03-5103.00-0096

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will receive an overview of what is expected of a petroleum officer and how petroleum impacts on the environment.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify federal laws, federally required plans, key personnel, and basic prevention and response steps to spills on both land and water.

CONDITIONS: Using the corresponding lesson plan and listed references.

STANDARD: IAW with the corresponding lessons instruction and AR 200-1, you will learn about prevention and containment/cleanup of spills and you will learn about SPCCP and the ISCP.

REFERENCES: AR 200-1.

INTRODUCTION

In 1992, the Federal Facilities Compliance Act was passed which did away with the federal government's claim of sovereign immunity. In less than two years, the Army incurred more than $10 million in fines and penalties -- many based on violations resulting from decades-old sites. As a petroleum officer, you should be fully aware of what is entailed in environmental considerations. You should also be aware that whenever you are discussing operations involving petroleum or other hazardous materials, you should stress the importance of environment protection.

1. Environmental Considerations.

In the introduction, we addressed environmental considerations. The following is a set of guidelines that will assist you in accomplishing this.

a. If a spill should occur, immediately take the following actions.

NOTE: A spill is defined as any quantity of a petroleum product over five gallons or any quantity of any other HW.

(1) Ensure safety.

(a) Evacuate the area if necessary for type of spill.

(b) Take personal precautions as detailed on the MSDS for the material spilled.

(c) Use the proper personal protective equipment.

(d) Extinguish smoking materials and all other sources of ignition.

(e) Turn power off if fire is a possibility.

(f) Ventilate the area.

(2) Stop the flow. If possible, shut off valves, and turn drums upright. Do NOT take unnecessary risks, but stop the flow without getting hurt or contaminated. If you do become contaminated, shower and change clothes a soon a possible.

(3) Contain the spill. Contain the spill by throwing absorbent, floor sweep, or dirt on it. Make dams to keep the spill from spreading further, and do not let it enter storm drains or other waterways. If containment is not possible, divert the flow to prevent the spill from entering any water source, including drains.

(4) Control traffic. Do not let others drive or walk though spills. Use common sense and call for help as soon as possible.

(5) Report the spill. Report the spill to your superior. Sound the alarm or give verbal warning. Have someone else call the fire department if the spill is something you cannot handle safely.

(a) Immediately report spills of any hazardous material other than petroleum product, regardless of quantity to the ECO.

(b) In the event of a reportable spill, the senior person in charge will make a copy of the MSDS involved for emergency response personnel.

(6) Clean up. If the spill occurred on concrete or asphalt and you have absorbed all of it with absorbent or dirt, scoop up the contaminated material, put it into a container marked "Hazardous Waste - Contaminated Absorbent (or Dirt)." Check with ECO for proper disposal.

b. When storing transporting, issuing, or using petroleum products, you should always consider spills. To minimize the likelihood of spills, be aware of the causes of spills.

(1) Natural (earthquakes, hurricanes, tornadoes, floods) - consider location, special structural devices.

(a) Mechanical (leaking valve, broken pipe, damaged storage tank) - PMCS.

(b) Human error (carelessness, lack of training, mistakes) - props training and updates, SOP.

(c) Trigger event (one of these occurs causing another to take place) - all of the above.

c. The best way to combat a spill is to prevent it!

(1) Identify petroleum storage areas and prioritize those areas based on type of fuel, quantity of fuel, frequency of transfer, proximity to high impact areas (for example, waterways, human habitation, protected areas).

(2) Establish an effective SOP -- one that is clear and enforced.

(3) Insist on PMCS.

(4) Understand the procedures to follow should a spill occur - Know your spill response plan!

(5) Train employees and continue to update that training.

2. Federal Laws.

The following federal laws impact on petroleum and water operations.

a. Clean Water Act.

(1) Requires an NPDES permit for discharge into waters from a point source.

(2) Requires preparation of an NCP, which provides for a response plan to catastrophic spills.

b. OPA of 1990.

(1) "Harmful quantity" considers public health or welfare or the environment of the United States.

(2) Applies to inland, coastal, and seawater as far out as 200 miles.

c. Resource, Conservation, and Recovery Act (RCRA).

(1) Regulates management of hazardous wastes.

(2) Includes the FFCA. Removes the waiver of "sovereign immunity" for federal facilities.

d. Comprehensive Environmental Response, Compensation, and Liability Act.

(1) Establishes a National Priority List for cleanup of most severely contaminated or long-term contaminated sites.

(2) Provides for a DERP.

e. Other Laws.

(1) In most cases, states implement these laws and can impose more stringent requirements. The more stringent requirement applies.

(2) The armed forces, when in a host nation, must comply with host nation requirements. Again, the more stringent requirement applies.

3. Defense Energy Supply Center.

DESC is the integrated materiel manager of wholesale fuels.

a. DESC stocks are positioned worldwide in DFSP. DSFC will fund environmental compliance costs and some environmentally-related costs.

b. The Environmental Guide, Fuel Terminal is an excellent resource for fuel handlers. It outlines emergency response procedures, discusses the environmental considerations associated with petroleum handling and storage, and provides a directory of state agencies.

4. Spill Prevention Control and Countermeasures Plan.

a. Under provisions of the CWA, installations which store any significant quantity of fuel or other hazardous materials are required to have a SPCCP. (For specific see AR 200-1, Chapter 8). The SPCCP identifies potential spill sites.

b. It identifies fuel storage locations, quantities, and types of fuels stored at each area; areas which could be affected should a spill occur; and measures in place to prevent the spread of the spill.

c. The plan predicts direction of flow, rate of flow, and total quantity which could be discharged for each site.

d. It must be certified by a registered professional engineer.

5. Installation Spill Contingency Plan.

a. The ISCP identifies resources and procedures to be used if a spill occurs.

b. The IOSC is specified in the ISCP. The IOSC coordinates and directs Army control and cleanup efforts at a spill.

c. Provisions for an IRT are specified, to include composition, response functions, and a training plan.

d. Annual training is required.

6. Federal laws/agencies and their impact on spill control.

a. A chain-of-command monitors spill containment/cleanup procedures. See figure 9-1 for the chain of command.

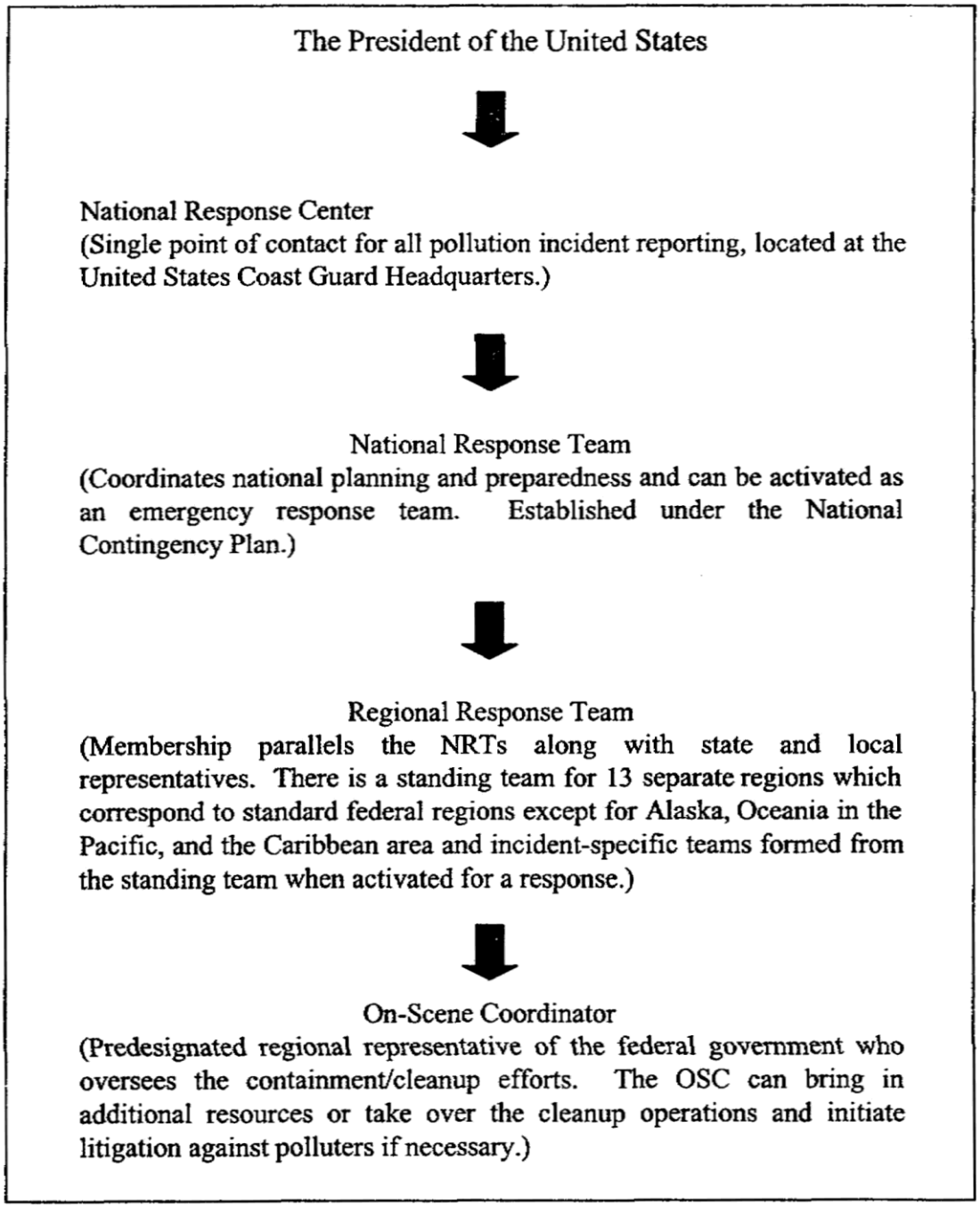

Figure 9-1. Chain of command

b. The USCG provides OSCs for water-based spills; the EPA provides OSCs for land-based spills.

c. Membership of the NRT includes representatives from the following agencies:

Environmental Protection Agency
Department of Agriculture
Department of Defense
Department of Interior
Department of Labor
Department of Transportation
Nuclear Regulatory Commission
Emergency Management Agency
United States Coast Guard
Department of Commerce
Department of Energy
Department of Justice
Department of State
General Services Administration
Department of Health and Human Federal Services

(1) The chair of the NRT is the EPA representative; the vice-chair is the USCG representative. During periods of activation, the chair is the member agency providing the OSC.

(2) The NRT assists in developing a national exercise program and provides expertise for specific incidents

7. Steps for Spill Response.

For any spill, the first step is to stop the spill! Upon detection, the proper authorities should be notified and the emergency response plan should be activated. Once the spill source has been identified and stopped, the second step is to contain the spill. Containment methods vary, but the intent is clear: Keep the spill from spreading and get it cleaned up! The third step, then, is clean up the spill. The fourth step is remediation and restoration of the site. The fifth and final step is disposal of the waste.

8. Spills on Land.

a. Determine what areas are at risk, the direction in which a spill would flow, and what containment devices/procedures would be needed.

b. The following are the most frequently used containment devices:

(1) Berms -- used in both fixed and temporary storage areas; constructed of concrete, block, or earth and designed to contain the entire contents of a tank plus one extra foot for overfill. Berm liners are required to prevent fuel from soaking into the soil.

(2) Dikes -- “retaining walls” constructed in the anticipated path of the spill.

(3) Ditches - dug to contain spills within a fuel area.

(4) Curbing - placed in transfer points, areas in which relatively small quantities may be spilled (for example, gas station).

(5) Grating -- allows overflow or spillage to accumulate in a tank (for example, garage).

(6) Slop tank - receives overflow in fixed area or is designated as such for off-grade fuel.

(7) Drip pans -- used extensively with equipment, during transfer operations, or for maintenance to collect small spills that routinely occur.

(8) Alarms/automatic shut-offs -- signal leaks immediately. Particularly useful with underground storage tanks; detects interstitial leaks between interior and exterior walls.

c. Improvised methods include sand bags, straw bales, dirt, or other absorbent materials. Containment is intended to restrict the flow of the spill to prevent additional contamination and enable cleanup to be done more easily.

d. Most field situations will include use of POL. Be prepared! At a minimum, carry shovels (nonsparking, such as aluminum, is recommended); sorbents; and drip pans and waste containers (55-gallon drum halves are dual purpose -- they can be used as drip pans and waste containers).

e. Though the initial cost of specialized sorbents may be higher than the cost of clay pellets, they are much more absorbent and burn much more efficiently, resulting in less waste.

f. Contaminated soil must be removed and disposed of IAW EPA regulations. Certain areas are more difficult than others to clean (oil can penetrate sandy areas such as beaches as much as 6 inches deeper than loamy soil; pipelines can run through areas with limited access). Heavy equipment such as scrapers and bulldozers may be needed.

9. Spills on Water.

a. Studies conducted in California show that most spills occur while ships are taking on their own fuel supply (bunkering). As a result, California requires all ships to use boom while at dock unless carrying nonpersistent (low flash point) fuel. Boom used at dock is one preventive measure that may be (and, in some cases, must be) used.

b. Containment on water is critical because the spill will move with the water making it difficult for the spill to be picked up. A spill can affect hundreds of miles of coastline within days. The most frequently used containment device is the boom. Available in different sizes and lengths, boom is placed downstream or below the spill and prevents the oil from moving with the current. Several sets of boom are normally placed as wave action or current strength can cause the product to escape the barriers. Boom is also used to protect the areas from the spill.

c. Time is one of the most critical factors in cleaning up an oil spill -- especially on water. As the petroleum weathers and deteriorates, aided by wave action, the product begins to “break up.” Loss of light ends causes the product to become more viscous, forming a thick mousse.

d. Cleanup must be IAW EPA regulations. Methods include:

(1) Skimmers and skimmer boats: Pick up the oil on adsorbent belt, oil is squeezed into a container.

(2) Sorbents: Designed to pick up petroleum products only.

(3) Chemical cleanup: If used, must obtain prior approval from EPA.

(a) Dispersants

(b) Gelling, sinking agents

(c) Microbiological organisms: Actually eat petroleum products

(d) Burning

10. Waste Disposal.

Disposal of waste must be IAW EPA requirements.

a. If the product contains lead, the waste must be disposed of through high-intensity burning. Using a closed incinerator, emissions are minimal and resultant ash is small.

b. If the product is unleaded, the waste can be disposed of through:

(1) High-intensity burning (usually the best method)

(2) Landfills (expensive to haul and store)

(3) Farming (contractor turns sludge into specially lined area, adds microbiological organisms to expedite the process)

(4) On-site bioremediation (microbiological organisms are introduced to contaminated area, soil is periodically turned and monitored for recovery)

11. Environmental Impact of Spills.

a. The Valdez (1989) tape, produced by the Cousteau Society, provides an overview of the impact of the largest spill to occur in the United States' waters (11 million gallons). It discusses cleanup techniques and weaknesses and gives excellent footage of fouled shorelines and cleanup.

b. The Fires of Kuwait (1991) tape documents the fire fighting of the torched oil wells in Kuwait. Footage includes the polluted areas. Highlights include excellent footage of extinguishing the burning wells and the multinational effort involved. This tape can be associated with the Persian Gulf War.

NOTE: When the Sea Island Terminal was deliberately opened, 294 million gallons were spilled in the Persian Gulf This pollution was separate from the torching of the 607 wells.

LESSON 9

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What plan identifies potential spill sites?

   A. SPCCP
   B. SCPPC
   C. ISCP
   D. IPSC

2. What plan gives lists of resources and personnel to contact if a spill occurs?

   A. ISCP
   B. SPCCP
   C. ISSCP
   D. SPPC

3. What is most often used as a preventive/containment device on water?

   A. Berm
   B. IOSC
   C. Boom
   D. Ditches

LESSON 9

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	A. SPCCP (page 9-4, para 4).
2.	A. ISCP (page 9-4, para 4).
3.	C. Boom (page 9-8, para 9b).

LESSON 10

QUALITY SURVEILLANCE

Critical Tasks: 03-5103.00-0096
01-5103.00-0044
01-5103.00-0004
01-5103.30-2075

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn when to sample, what tests are to be performed, and what is the significance of those tests.

TERMINAL LEARNING OBJECTIVE:

ACTION: To identify and describe essential characteristics of petroleum products, quality surveillance procedures, laboratory test requirements, significance of lab tests, causes of contamination and deterioration, and reclamation and disposition procedures.

CONDITIONS: Given all necessary references and this corresponding lesson plan.

STANDARDS: Performance will be IAW references.

REFERENCES: MIL-HDBK-200, FM 10-67-2, FM 10-67-1, and NAVEDTRA 10833-C.

INTRODUCTION

To have effective petroleum management programs, you must be familiar with quality surveillance procedures, laboratory test requirements and significance, types of contamination, causes of deterioration, and reclamation and disposition procedures.

1. Quality Surveillance Program.

a. Definition. All measures taken to ensure that petroleum products which have been accepted by the government as being of the required quality are still of the required quality when delivered to the user. Quality surveillance includes watching over and caring for products during all storage and handling operations, following to handling procedures and methods designed to protect quality, and examining and testing of products in storage and on change of custody.

b. Terms. You may hear the term “quality assurance” used synonymously with the term “quality surveillance;” however, there is a difference in the terms. Quality assurance is the government's program to determine if the manufacturer has fulfilled contractual obligations as to the correct quantity and quality of product QA is complete when the product is accepted by the government and becomes government owned. QS, begins when petroleum products are accepted by the government. Quality surveillance applies to those products in military pipelines or tankage. It also applies to those government-owned products in commercial pipelines or leased tankage.

c. Responsibility. Every agency in the supply system that transports, stores, distributes, or issues petroleum products is responsible for some phase of quality surveillance. Every individual who physically handles petroleum products shares this responsibility.

(1) CONUS. The petroleum quality assurance representatives of the DLA are responsible for providing test results on batches product as they are manufactured. The military service having physical possession of the petroleum products at a GOGO facility is responsible for setting up and maintaining a QS program as prescribed in MIL-HDBK-200 and AR 703-1. Representatives of the Army Petroleum Center New Cumberland Army Depot and Defense Depot Tracy, San Francisco, CA monitor the quality surveillance program.

(2) OCONUS. Under provisions of the MIL-HDBK-200, the JPO, is the area coordinator for the quality surveillance program within its command areas. In turn, each military service within each command is responsible for setting up and maintaining a quality surveillance program, as well as for maintaining and operating laboratories required to perform their tests.

e. Importance of QS. Essential characteristics are set up and are published as specifications. The characteristics listed are quantitative measures of the physical and chemical properties of the product, which, taken together, are essential to make it appropriate for its intended use. However, these properties depend upon the composition of the product. Any change in the product may result in such marked changes that the product becomes unsuitable for its intended use. The issue of unsuitable products to combat units can produce critically damaging results. Such products could cause the loss of personnel and equipment and might be the deciding factor in the success or failure of a mission.

f. Classifications of QS. In quality surveillance, petroleum products are classified into one of three categories:

(1) OG -- the product meets or exceeds all specification requirements.

(2) SFU -- one or more tests on the product fail specification requirements but are within deterioration/use limits.

(3) NSFU -- one or more tests of the product fail to meet deterioration/use limits.

2. Storage Operations. Minimum procedures required for proper quality surveillance of storage operations are as follows:

a. If possible, ensures tanks are used for one type of product only. Clean storage tanks when products are changed.

b. Keep records on all tanks listing test results. Use these records to set up tank cleaning schedules.

c. Segregate products and grades in separate systems when possible, and identify lines and facilities. Protect the product using blank flanges, bleeder valves, or by removing section of pipe. Segregation by a single valve is not sufficient.

d. Consolidate on-specification stocks. This will keep storage tanks filled, reduce breathing and evaporation losses, and keep other tanks empty for receipt of new product.

e. When receiving product into partly filled tanks, ensure that it is the same product type and the same quality or better. Do not receive product of uncertain quality into a partly filled tank.

f. Ensure the product is allowed to settle at least the minimum time allowed IAW Mil-HDBK-200.

g. Remove water daily from working tanks and weekly from other tanks.

h. Do not maintain water bottoms unless specifically authorized to do so. Transfer the contents of leaking tanks ASAP after discovery of leak.

i. Sample and test dormant stocks as prescribed in surveillance tables in MIL-HDBK-200 Table II (basically every 6 months for bulk dormant stocks or every 12 months for packaged products) and Table I (when operating stocks fall into one of the prescribed categories).

3. Loading Products.

a. Ensure tankers are used for one product type only.

NOTE: Tanker may be a land vehicle, barge, or ship.

b. Inspects tanks for cleanliness and vehicle for safety and proper mechanical operations.

c. Verify all forms and signature cards.

d. Verify amount loaded into tank.

e. Place seals on tank cover, valves, and manifold (when using civilian contractors).

4. Unloading Procedures.

a. Verify all paperwork and ensure seals have not been tampered with. Immediately report any discrepancies.

b. Sample IAW MIL-HDBK-200, Table III.

c. Gage tank(s) before and after receipt.

d. Fill out necessary forms.

5. Pipeline Operations. Petroleum quality assurance representatives exercise surveillance over pipelines, their duties include:

a. Handling of batches and cycling (pumping rates, progress checks at test points).

b. Generating, handling, and evaluating interface mixtures.

c. Receiving batches into tanks.

d. Verifying product quality.

e. Monitoring the levels of additives.

f. Making periodic checks.

6. Characteristics of Petroleum Products.

a. Many specialized petroleum products are developed by the military services to ensure adequate performance of complex and highly specialized military equipment. Hence, each petroleum product is designed or formulated to have certain characteristics. These characteristics can be physical, how the substance acts by itself or chemical, how the substance reacts with other substances. An example of a physical characteristic is density, and an example of a chemical property is corrosiveness.

b. Chemical and physical characteristics can be farther broken down into five categories. These five categories are the main areas of interest in which petroleum products are tested.

(1) Volatility. Volatility is a measure of the tendency of a liquid to change to the vapor state; such as water changing into steam.

(2) Viscosity. Viscosity is a measure of the resistance of a liquid, or semiliquid, to movement. The higher the viscosity the more resistance to movement. For example: molasses moves slowly and has a high viscosity; water moves quickly and has a low viscosity.

(3) Stability. Stability is a measure of the product's tendency to retain its physical and chemical properties. This characteristic helps determine the effects of storage on the product and its performance at high temperatures.

(4) Corrosiveness. Corrosiveness is a measure of the product's tendency to slowly wear away objects in contact with it by chemical action.

(5) Quality Control (Cleanliness). While this category does not really measure a characteristic of a product, it is an important group of tests. This group of tests can aid in the early detection of contamination or deterioration of products before their characteristics change. They are also a measure of good petroleum handling techniques or the lack of them.

c. The mishandling, weathering, or contamination of a petroleum product can cause physical and/or chemical changes in the product. Changing any characteristic of the product can cause it to be unsuitable for its intended use. To ensure product suitability at all times, the military monitors the product from manufacture to consumption. This is done by taking samples and having them analyzed at a petroleum laboratory.

d. The laboratory will perform tests that determine critical properties, or characteristics, of the product. Some of the possible tests are: flash point, vapor pressure, sediment, and water, viscosity, and distillation.

7. Determining Sampling and Testing Requirements.

a. The minimum sampling and testing frequency of the product is depends on the type of product, location, type of storage, and when it was last tested. For sampling dormant stocks, see MIL-HDBK-200, Table II, and for moving stocks, see Table III. Petroleum product mandatory sampling and testing fall into five categories: before acceptance of delivery from a manufacturer; whenever contamination or deterioration is suspected; after movement of products in bulk; before issue to individual pieces of equipment; or as a periodic check on filter effectiveness. Each of these categories are covered by a specified test series.

(1) Type A Test Series. This test series is done on all petroleum products prior to the manufacturer loading the product for shipment to the military and immediately before the military takes possession of the product. All tests listed in the specification for the product are performed.

(2) Type B-1 Test Series. This test series is done to check the characteristics most likely to have been affected by moving bulk products.

(3) Type B-2 Test Series. This series is done to verify the characteristics of products that have deteriorated due to age.

(4) Type B-3 Test Series. This series is done when a product is suspected of being contaminated.

(5) Type C Test Series. Is done as a final check before issue for consumption by a tank vehicle or as an initial verification of product type when receiving product from another unit. When receiving product after shipping from a manufacturer, a Type C series is done to verify product type and start receipt operations; however, type A series is required before final acceptance of the product is given. (The monthly filter effectiveness test is type C series plus a Millipore test).

NOTE: Turn to Table IV-A through IV-G in MIL-HDBK-200.

b. After finding the type series to perform on the product in MIL-HDBK 200, Table III, the specific teats to be done are found in Tables IV A-G. The specific tests done in each series depend on the type of product being tested. Each test determines a critical property of the product; however, a test, such as distillation, may determine more than one critical property. For example the tests required on diesel fuels by series are given in Table 10-1.

Table 10-1. Test Required for Diesel Fuels

	DIESEL FUELS					
TEST	B-1	B-2	B-3	C		
Appearance		X	X	X	X	
Color	X	X	X	X		
Specific Gravity		X	X	X	X	
Distillation	X	X				
Flash Point	X	X	X	X		
Carbon Residue	X	X				
Cloud Point		X				
Pour Point		X				
Corrosion	X					
Cetane Index		X				
Viscosity	X					
Water & Sediment by Centrifuge				X		
Particulate Contaminate				X		
Accelerated Stability				X		
SULFUR	X					

* For diesel fuel Type B-3 and C series are the same; this is not true for all products.
** Type A testing is not listed; when this series is required, all tests listed in the specification for that product are performed.

8. Significance of Tests.

We will limit our discussion of specific tests to the ones you will most likely use on a routine basis. Additionally, we will group these tests by the characteristic which they measure.

a. Volatility tests. Flash and fire points tests are performed on light distillate fuels such as diesel and JP8, lubricating oils, hydraulic fluids, gear oils, and brake fluids. **Aviation and motor gasolines, JP4 and other naphtha-based fuels do not have flash or fire points tests performed on them. Naptha-based fuels have a flash point below -50°C.** The flash point of a product is the temperature at which the product first gives off sufficient flammable vapor to ignite with application of an outside heat source. The fire point is the temperature at which the product vapors will continue to burn without the application of an outside heat source. The fire point of any product ranges about 10° to 70°C higher than its flash point. These tests are performed to ensure that products have not been contaminated with low flash point products and to ensure new products have been refined properly. These tests ensure that the products flash and fire points are above the expected operating temperatures. The flash point requirement is usually about 50°C above the expected operating temperature.

Off-specification products are disposed of or blended with suitable quantities of an on-specification product. Use of off-specification products could cause engine or seal blow out, or start a fire. There are three principal methods of determining flash and fire point:

(1) The Cleveland Open Cup -- determines the flash and fire points of oils.

(2) The Pensky-Martens Closed Cup -- determines flash points of distillate fuel oils such as diesel and burner oils.

(3) Tag Closed Cup Method - determines flash points of jet turbine fuels such as JP8.

b. Distillation. This test is performed on light distillates such as jet turbine fuel, diesel fuel, gasolines, and kerosene. This test evaluates vaporization characteristics of the fuel which aids in the prediction of performance characteristics. Gasoline must be sufficiently volatile to permit easy starting but not so excessively volatile that excessive evaporation loss occurs or that premature vaporization in carburetors or fuel lines takes place. Incompatibility between fuel and engines due to vaporization characteristics could lead to equipment loss or damage.

c. Vapor Pressure. All liquids tend to vaporize as a result of positive pressure exerted by the liquid. By placing a liquid in a suitable container under controlled conditions, an accurate measure of this vapor pressure can be determined. Vapor pressure is an important factor in all gasolines from a safety and performance point of view. In internal combustion engines, the fuel must vaporize into the cylinder through the carburetor into the manifold. If the vapor pressure is too high, the fuel will vaporize in the fuel pump and feed lines causing vapor lock. If the vapor pressure is too low, the fuel will not vaporize readily enough, resulting in unevenness of

operation and hard starting. In aircraft, the vapor pressure must be high enough to allow good performance at low altitudes but low enough to prevent vapor lock at high altitudes. The Reid Vapor Pressure Test method is normally used to determine vapor pressure.

9. Viscosity tests.

a. Cloud and Pour Point. These tests are performed on heavy distillate fuels and oils. The cloud point of a product is the temperature at which its paraffin (wax) content, normally held in solution, begins to solidify and separate into tiny crystals, causing the product to appear hazy. The pour point is the lowest temperature at which it can be poured.

(1) Products with high cloud points tend to form wax crystals easily. Cloud point test is useful in estimating the temperature at which screen filters in an engine would become clogged, or pipelines might become clogged if the products flowing through it have high cloud points.

(2) Pour point is of greater value because it has a wider significance than cloud point. The pour point is of significance when lubricating oil is used in machines exposed to low temperatures. Heavy distillates slowly lose viscosity until they can not move. For example, aircraft flown at high altitudes where temperatures are very low must use lubricants that have low pour points. Pour point is significant for diesel fuel in establishing the lowest temperature at which the fuel is still fluid enough to be pumped. Pour points can be lowered but this increases the volatility of the fuel at the expense of lowering the power content (BTU) and lowering the flash point of the fuel. Therefore, the pour point should not be specified lower than is necessary for the service for which the fuel is used.

b. Freezing Point. This is an important characteristic of light distillates such as aviation gasoline and jet fuels. Light distillates will suddenly lose all viscosity within one or two degrees as the product freezes. The freeze point of a product must be very low to prevent solidification of any of the component hydrocarbons, which would cause interference with fuel flow through fuel filters and lines. The freeze point is determined by cooling and stirring the sample in a cooling bath until the first slurry of crystals appear.

c. Viscometer Tests. Viscometers measure the flow of a product at a precise temperature; usually at expected operating temperature. There are three tests that use viscometers: Kinematic Viscosity; Saybolt Universal Viscosity; and the Saybolt Furol Viscosity Test. A viscometer is a calibrated glass instrument composed of one, two, or three bulbs connected by a small tube. The test is conducted by inserting a portion of the product into the bulb of the viscometer. The product is then allowed to flow between two points marked on the tube. The time measured for the product to complete the flow is used in a calculation. The calculation result is a number that rates the viscosity to the product. Each petroleum product has a precise range of viscosity.

10. Stability Tests.

a. Jet Fuel Thermal Oxidation Stability Test. This test is run on jet turbine fuels such as JP8. The thermal stability of the fuel is its resistance to chemical and physical changes upon exposure

to high temperatures. This shows the fuel's performance during jet aircraft operation and is used to assess the stability of a fuel at a given temperature. Unstable fuels deposit decomposition products in the fuel system components of jet aircraft which could result in engine failure.

b. Existent Gum. This test is run on gasolines and jet turbine fuels. High gum content fuels may cause deposits of resinous, or gummy, materials in the induction system or intake valves causing them to malfunction. The gum is firmed in the fuel by the oxidizing process. Temperature fluctuations cause storage tanks which are vented to the air to breathe. This causes the fuel to oxidize and form gum. Usually a high and normal looking, dry in appearance, gum content shows deterioration and a high and oily, or wet in appearance, gum content shows contamination with a heavier product.

11. Corrosion Tests.

a. Petroleum products are most likely used in contact with metal. Since it is essential that the metal not be subjected to any corrosive action of a product, it is necessary to test the product for corrosiveness. The substances most likely present in petroleum products hat cause corrosion are sulfur and sulfur compounds. Sulfur or sulfur compounds may be desirable or undesirable in lubricating oils depending on their intended use.

(1) Sulfur is desirable in certain lubricating oils because it increases their ability to stick to surfaces, thus enhancing lubrication. However, these lubricating oils cannot be used where copper, brass, or other nonferrous metals e present because sulfur is corrosive to these metals.

(2) Sulfur and sulfur compounds are undesirable in fuels. When the fuels are burned, the sulfur is converted into sulfur dioxide and sulfuric acid. These two compounds are highly corrosive to all metals including steel and other ferrous metals. A product that is too corrosive may cause engine failure or failure of bearings and ball joints.

b. Copper Strip. This test is performed on gasolines, turbine fuels, oils, and greases. In this method, a copper strip is inserted in a test tube, then the test tube is filled with enough product to cover the copper strip. The test tube is placed in an oven or hot water bath for a set amount of time. The exact temperature of the bath and duration of the test varies by product. After the time has elapsed, the copper strip is wiped free of product then compared to a standard discoloration set of copper strips. This comparison yields a rating of the corrosiveness of the product.

c. Acid Number. By precisely measuring the amount of a base used to bring a product to a neutral state, the relative acidity of a product can be determined. The relative acidness or base character of a product is based on the pH scale. The scale ranges from 0 to 14, water has a pH of 7 which is neutral. Acids are defined as having a range of 0 (very acidic, like sulfuric acid) to 6.9 (mildly acidic, like lemon juice). Bases occupy the other end of the scale 7.1 (mildly basic, like lime) to 14 (very basic, like sodium hydroxide).

12. Quality Control Tests.

a. Specific Gravity and API Gravity. All petroleum products have either the specific gravity or the API gravity test performed on them to determine their density. This test is generally used as a quality control indicator and to make volume corrections. Specific gravity is the ratio of the weight of a given volume of a substance to the weight of an equal volume of water. Normally the specific gravity of petroleum products is converted to degrees API. The relationship of API degrees to specific gravity is expressed in the formula:

$$\text{Specific gravity} = \frac{141.5}{131.5 + \text{API}^\circ}$$

Water has a specific gravity of one and API gravity of 10 degrees. Petroleum products have a density less than water, thus an API gravity greater than 10 degrees. The API gravity scale was developed to eliminate the problem of working directly in specific gravity. A hydrometer is used to take API gravity readings. An abnormal API gravity reading is reason to suspect contamination of the product with another product

b. Appearance/Workmanship. This is a visual test performed on all petroleum products to determine if they look different from what they should. The product should be clear (free of suspended matter), bright (sparkle transmitted in light), homogeneous (uniformly mixed; not separated or stratified), and not have visual sediment or water in it. Solid and liquid contamination can lead to restriction of fuel metering points, improper seating of inlet valves, corrosion, fuel line freezing, gel formations, filter plugging, or failure to lubricate. Product containing visual sediment and water should be filtered and retested before issue.

c. Color. This test is performed on many petroleum products to detect contamination and deterioration and to identify products. In refining, the color test is used to determine uniformity of the product batch. Once the product is in the distribution system a color test is used as a quick indicator of deterioration and/or contamination. If a product is darker than expected, it could indicate contamination with a heavier product. If the color is light than expected, contamination with a lighter product is possible. Further testing may be required to determine if the product can still be used. For oils and diesel fuels, the ASTM Method is used; for white oils, kerosene, and gasolines, the Saybolt Colorimeter Method is used.

d. Aqua-Glo Water. This test is run on aviation fuels and selected ground fuels to detect harmful levels of water contamination. Water can become a petroleum contaminate at any stage from the refinery to ultimate use. Extreme care must be taken to eliminate water from fuel. Water in aviation fuels can freeze and form ice at altitudes above 8,500 feet. The resulting ice can clog on-board fuel filters and prevent fuel flow to the engine. For this reason water is generally limited to 10 PPM maximum. If the result is higher, the fuel should be recirculated through a filter/separator and retested.

e. Water Reaction. This test is run on aviation fuels to determine the presence of alcohol, aromatics, or surfactants. The presence of alcohol or aromatics increases the water content of the fuel. This water falls out of the fuel at low temperatures and clogs fuel filters and lines. The surfactants change the flow characteristics of the fuel and degrade the performance of the fuel and engine.

f. Millipore. This test is performed on fuel to determine the amount of particulate (solid) contamination in the fuel sample. Too much solid contamination can clog engine filters, fuel lines, carburetor, and injectors. Recirculating the product trough a filter/separator usually solves this problem.

g. Fuel System Icing Inhibitor. This test is run on jet turbine fuels. FSII is an additive to jet turbine fuels that prevents dissolved water from freezing at altitudes above 8,500 feet. Dissolved water is water contained between the molecules of fuel and cannot be seen with the naked eye. Free water in fuel makes the fuel appear cloudy or form a puddle at the bottom of the fuel. FSII is pulled easily out of the fuel by free water. When the fuel passes through a filter/separator, the free water and the FSII it contains are separated from the fuel. This leaves the fuel with low levels of FSII decreasing its effectiveness. The lack of FSII in fuel can be an indicator of poor fuel handling techniques.

h. Ash. This test is run on fuel oils and lubricants to determine the amount of ash forming materials present in the product. Ash-forming contaminates, such as rust, sand, or metallic salts, can abrade metal surfaces, clog injection nozzles, and form deposits. If ash content is too high, the product should not be used. If the ash content is too low, it could indicate loss of additives.

i. Carbon Residue. This test is performed on distillate fuels (diesel, JP8), residual fuels (heating oil, burner oil), and lubricating oils. The amount of carbon residue is an indicator of the crude oil base used to manufacture the product. Paraffin-based products have low carbon residue while asphalt-based products have high carbon residue. Distillate fuels that have a high carbon residue can leave a deposit in an engine causing hot spot ignition in the combustion chamber and fuel injector blockage. Residual fuels with high carbon residue may cause problems in heat generating equipment by clogging burners and creating severe pollution. Lubricating oils that have high carbon residue are poor lubricants because they leave deposits that cause excessive wear.

13. Contamination, Deterioration, Reclamation, and Disposition.

NOTE: MIL-HDBK-200, Table X provides characteristics of the contaminates.

a. Contamination. A contaminated product is one that contains some material not normally present, such as dirt, rust, water, or another petroleum product. Contaminates may modify the characteristics of the product or interfere with the machines in which the product is used. Using contaminated products could result in the loss of time, equipment, or life. A product may be contaminated by accident, inability to follow prescribed petroleum handling procedures, gross carelessness, or sabotage. In most cases, a contaminated product can be detected by unusual

color, appearance, gravity, or odor of the product. However, sometimes contamination can only be detected by a laboratory and all products suspected of contamination should be reported to the chain of command. Some of the more common types of contamination are:

(1) Dirt. The presence of dirt in a petroleum product is usually the result of inadequate cleaning and inspection of tanks or containers.

(2) Rust. Rust is the product of the corrosion of metal. It is brittle, powders readily, and insoluble in water. It may form troublesome suspensions.

(3) Mill-Scale. This is a magnetic product formed during manufacturing of metal parts. It is largely responsible for the blue-black appearances on finished metal surfaces. It is a very serious contaminant in bulk products pumped through new pipes during the first few days or weeks of use. The scale is brittle and cracks readily. Corrosion starts at these cracks and spreads under it causing it to flake off. Settling is not a satisfactory method of eliminating the scale, and filtering is recommended.

(4) Water is present in all fuel systems, as it can enter the system at any point. The water may be present as dissolved (not visible to the naked eye), entrained (gives the product a hazy appearance), or free water (droplets in the bottom of product). In any form, water is a dangerous contaminant. It can freeze and clog filters and lines, and result in the loss of life or equipment.

(5) Microbiological growth. This growth consists of protozoa, bacteria, and fungi organisms that grow in the fuel/water interface. These organisms hold rust and dirt in suspension, stabilize water emulsifications, and cling to the sides of all containers. This causes erroneous readings in fuel systems, sluggish fuel control operations, and sticking of flow dividers. The best method of controlling microbiological growth is good housekeeping; however, FSII has proven to be an effective biocide.

(6) Fibers. This is caused by paper type filter cartridges, cloth and cotton waste. The fibers enter the product flow when the filters burst or when new filters are placed into operation. After changing the filters, if they had burst, recirculating the product through the filter/separator usually solves this problem. Left unchecked the fibers can clog engine filters, flow lines, injectors, and carburetors.

(7) Commingling. Commingling is the contamination of a petroleum product with another petroleum product. Some causes of commingling are: inadequate cleaning of lines, mishandling of manifolds, and leaks in tanks or valves. Commingling can be negligible or serious, depending upon the product contaminated, the contaminating agent, and the amount of contamination. Some of the effects of commingling are: loss of power in fuels, increase in volatility, increase in gum content, formation of heavy sludge, degradation of thermal stability, and increased water separation time.

b. Deterioration. The characteristics of a product change over time. The changes may be initiated or hastened by the conditions of storage and are not normally observable by the

personnel handling the product. Therefore, the quality at issue depends on laboratory control programs. The most common forms of deterioration are weathering, gum formation, and loss of additives such as FSII and color.

(1) Weathering. Weathering is the loss of the more volatile components of some products. Its effects are most noticeable in aviation and motor gasolines. Because these products produce enough vapor pressure to rupture a sealed storage tank, the storage tanks are vented to the air. As the temperature rises, vapor is pushed out the vents. As the temperature falls, air is sucked in the vents. Through this cycle, the products lose their more volatile components. The more volatile components are needed for easy and cold weather engine startup and engine warm up. The less volatile fuel may cause trouble in engine performance.

(2) Gum formation. Gum formation is the most common and troublesome form of deterioration. It is caused by the presence of unsaturated hydrocarbons in the fuel. In the presence of oxygen, these unsaturated hydrocarbons change into gummy, and eventually resinous, materials The gummy substances remain in solution but are difficult for the engine to vaporize and can form deposits on the cylinder walls of engines and carburetors, eventually clogging them. The gum deposits also increase the carbon build up in engines, resulting in higher costs of engine maintenance. The resinous materials settle to the bottom of the product as they are formed but are very difficult to clean out of the bottom of the container. Gum and resin inhibitors are added to products but are effective for a limited time only.

(3) Loss of additives. The causes of the loss of additives, such as FSII, and color, have not been established with certainty. These forms of deterioration are considered together because they are all known to occur during storage. The loss of additives may be a postponed result of manufacturing mistakes, poor product handling, or contamination. The effect on the product is determined by what type of additive was lost. For example: Losing oxidation inhibitors decreases the length of time a product can be stored; loss of color by itself is unimportant but indicates that the product has been oxidized and further evaluation may be necessary; loss of FSII could allow fuel lines to freeze at higher altitudes. Good petroleum handling and quality surveillance measures are the best way to prevent loss of additives.

c. Reclamation and Disposition.

(1) Generally, suspected deterioration or contamination must be confirmed by laboratory test. Reclamation refers to the procedures required to restore or change the quality of the product to make it usable. The laboratory should be consulted before any procedures to reclaim products are initiated. The methods of reclamation include downgrading, blending, filtering, dehydrating, and inhibiting. It is preferred to restore the product to its original intended use by the most cost effective method; if this is impractical or impossible, then the next priority is to make the product usable at some level. In deciding which reclamation method to use, consider the following factors:

- Degree of contamination and deviation from required product specifications.
- Probable end use of product in present condition, after laboratory analysis.
- Probability of restoring product to usable quality (original intended use or other end use).
- Location and quantity of questionable product, need for unreclaimed product at any facility, and estimated consumption rate.
- Availability of material and equipment necessary to reclaim product.

(2) Products should be segregated by type of product. Send representative samples, by product and tank, to the laboratory. If appropriate, the product may be issued for immediate use, further storage is not recommended. If the product can not be issued continue with other options.

d. Downgrading. Products that can not be reclaimed for their intended use may be downgraded to a lower quality product, as long as the product meets the use limits for the lower quality product. For example, diesel fuel that cannot be reclaimed for use in motor vehicles may be used as fuel in heating plants or stationary engines, as long as it meets the use limits for to which type of product it has been downgraded.

e. Blending.

(1) Blending is the mixing of two products, usually the deteriorated/contaminated product with a product that is on specification. However, the two products should be of the same type and intended for the same original use. All blending must be strictly controlled and the blending ratios are determined by the laboratory. An example of blending is mixing of 100 gallons of unusable JP8 with 10,000 gallons of on-specification of JP8, resulting in 10,100 gallons of JP8 that is suitable for its original intended use The actual blending ratio would be provided by the laboratory.

(2) Occasionally, a combination of blending and downgrading is used. This is done primarily when there is a large quantity of grossly contaminated/deteriorated product which would require the use of more on-specification fuel than is practical to make the product usable for its intended purpose (for example, not enough storage space, or create more product than can be issued quickly for consumption). Only enough on-specification product would be blended with the grossly contaminated/deteriorated product to bring it within use limits of the lowest type of possible use. An example is 10,000 gallons of grossly contaminated JP8 has 250 gallons of on-specification JP8 blended to it making it usable as fuel for a heating plant.

d. Dehydrating. Water will generally settle out of the products if they are allowed to stand undisturbed for a few days for lighter products or a week or more for heavier products. Water is then bled off via the water draw-off valve. Water can also be extracted by using a filter/separator.

e. Filtering. Filter/separators with standard DOD filters are highly effective in removing water and solid contaminates. Quality checks for water and sediment are required downstream of the filter/separator. Element change criteria include product quality checks.

f. Inhibiting. This is the reintroduction of lost additives to the product. This can be done with most additives. If the additive content of the product falls below use limits, more of the same type of additives can be introduced to the product to bring it up to use levels. An example is the FSII content of 500 gallons of JP8 has fallen to .025 percent. Enough FSII is added to the P8 to bring the FSII content up to .05 percent, the use limit for FSII content. The JP8 is then slated for immediate consumption.

g. Disposal. Disposal is the least preferred method of disposition. The military service will get no use at all from the product. This means it costs money to buy the product and then more money to dispose of it. This wastes money that could be used elsewhere. A product must be disposed of IAW with all pertinent DOD, service branch, and EPA regulations. Improper disposal/use of the product could result in fines being levied or jail sentences for involved parties.

LESSON 10

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What is quality surveillance?

A. All measures taken to ensure that petroleum products that have been accepted by the government are still of the required quality, to include watching over and caring for products during all storage and handling operations.
B. Monitoring the tank farm.
C. Shipping bad fuel to be recycled.
D. All measures necessary to determine and maintain the quality of products in order for the product to be used for its original intended purpose.

2. What are the three quality classifications of petroleum products?

A. On grade; suitable for use; and not suitable for use.
B. Kerosene; diesel; Jet fuel
C. Off grade; suitable for use; and not suitable for use
D. JP-4; JP-8; MOGAS

3. What are the five general categories of petroleum characteristics?

A. Volatility; Viscosity; Stability; Corrosiveness; Quality Control (Cleanliness)
B. Usable; Stability, Quality Assurance; Noncorrosive; Volatility
C. Volatility; Viscosity; Stability; Noncorrosiveness; Quality Control (Cleanliness)
D. Usable; Stability, Quality Assurance; Corrosiveness; Quality Control (Cleanliness)

4. What are the different groups of test series?

A. A; B-1; B-2; B-3; C
B. A; B; C
C. A; B-1; C
D. A; B; F; C

LESSON 10

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. D. All measures taken to ensure that petroleum products tat have been accepted by the government are still of the required quality, to include watching over and caring for products during all storage and handling operations. (page 10-2, para 1a).

2. A. On grade; suitable for use; and not suitable for use. (page 10-3, para 1f).

3. A. Volatility; Viscosity; Stability; Corrosiveness; Quality Control (Cleanliness). (page 10-5, para 6b).

4. A. A; B-1; B-2; B-3; C. (page 10-6, para 7a(1)-(5)).

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LESSON 11

PETROLEUM REQUIREMENTS COMPUTATION

Critical Tasks: 01-5103.00-0003
03-5103.30-2156
03-5103.00-0080
03-5103.30-1147

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will be given a basic knowledge of how to compute petroleum requirements for modern combat forces. Army units will be the major focus during this lesson. Also, we will address how the Air Force, Navy, and Marine Corps determine their petroleum requirements.

TERMINAL LEARNING OBJECTIVE:

ACTION: Compute Army petroleum requirements using various DA-approved methods to include automated supply programs and discuss other services' methods of computations.

CONDITIONS: Using this lesson and FM 101-10-2.

STANDARDS: IAW FM 101-10-2.

REFERENCES: FM 101-10-2

INTRODUCTION

Proper petroleum planning can only be done if the officer knows what the requirements are for his mission. With limited resources, storage, and distribution assets, it is essential that forecasts be accurate for each type of fuel. The supply of fuel was critical to the success or failure of an operation. A good example of this was seen in World War II. As petroleum officers, we know that it is extremely important to have the right amount of fuel at the right place; today's modern combat forces are no more effective than their counterparts of World War II.

1. Bulk Petroleum Computation Methods.

There are six methods of computing petroleum requirements.

a. The Historical Method is the considered the most accurate method.

(1) The information was derived from actual consumption data recorded from previous events. The information is only accurate if certain conditions apply:

- Same vehicles/type of exercise.
- Similar location/terrain.
- Similar weather.

(2) Recordkeeping for actual consumption during major training exercises and tactical marches is essential. Get the information from DA Forms 4702-R, 3643, or 3644, the monthly accountability reports, maintenance records, and logistics reports.

b. The Equipment Consumption Method - determines consumption for all individual pieces of equipment for one day except for combat tracked vehicles.

(1) . Must know what equipment is to be used (LIN from TOE, TDA, or equipment listing) and the geographical area.

(2) Usage rates vary by geographical location. Data are found in FM 101-10-1/2:

(a) Table 2-12 - consumption rate in hours or kilometers, need to get fuel type and equipment type.

(b) Table 2-13 -- usage rate by hours or kilometers based on equipment type from Table 2-12.

NOTE: (Table 2-12) (Table 2-13)

Equipment Consumption	**X**	Area Usage	=	Fuel Requirement Per Equipment Rate

Fuel requirement X Equipment quantity = Total Fuel Requirement.

EXAMPLE 1: Compute the fuel requirement for one day of operation given the following information:

Location: Korea

LIN	Nomenclature	Qty
X52065	Truck, Lift, Fork	1
K30383	Hcpt Cgo Trans Ch47	1

SOLUTION 1:

Step 1 -- Find Consumption rates

LIN X52065; Table 2-12 page 2-46: Consumption rate = 1.30 gallons/hour; Fuel type is MOGAS; Equipment type is MH

LIN K30383: Table 2-12, page 2-31: Consumption rate = 478.80 gallons/hour; Fuel type is JP4; Equipment type is AV

Step 2 -- Find usage rates from Table 2-13 for Korea: MH - 20 hours; AV - 4 hours

Step 3 - Multiply the consumption factors times the usage factors

MG: 1.30 X 20 = 26 gallons

JP4: 478.8 X 4 = 1,915 gallons

EXAMPLE 2: Compute the fuel requirement for one day of operation given the following information:

Location: Germany

LIN	Nomenclature	Qty
X60833	M-38 Trk Util Rt	4
J51480	Generator Set	2
X48914	Trk Fl Mlt 6 Rops	5

SOLUTION 2:

Step 1 -- Find Consumption rates

LIN X60833, Table 2-12, page 2-49: Consumption rate = 0.0373 gallons/kilometer; Fuel type is MOGAS; Equipment type is WV

LIN J51480, Table 2-12, page 2-29: Consumption rate = 3.5 gallons/hour; Fuel type is MOGAS; Equipment type is GN

LIN X48914, Table 2-12, page 2-45: Consumption rate = 478.80 gallons/hour; Fuel type is Diesel; Equipment type is MH

Step 2 -- Find usage rates from Table 2-13 for Europe: GN - 12 hours; MH - 20 Hours; WV- 100 km

Step 3 -- The consumption factors X the usage factors X quantities.

MG: 0.0373 X 100 = 3.73 gallons X 4 = 15 gallons

3.5 X 12 = 42 gallons X 2 = 84 gallons

Diesel: 5.0 X 12 = 60 gallons X 5 = 300 gallons

c. Combat Profile Method is only used for "combat tracked" vehicles. Because of its weight and size, a tracked vehicle consumes fuel at different rates based on its mode of operation. This method is similar to the equipment consumption method. The consumption is determined by knowing what the consumption rate is in each mode and how many hours it will operate in that mode.

(1) Table 2-12 gives consumption rates per hour in each mode.

(2) Usage rates are obtained from Table 2-14 or given by the commander.

NOTE:

(Table 2-12)		(Table 2-14)	
Idle Consumption Rate	X	Area Usage =	Idle Fuel Requirement

PLUS

(Table 2-12)		(Table 2-14)	
Xctry Consumption Rate	X	Area Usage =	Xctry Fuel Requirement

PLUS

(Table 2-12)		(Table 2-14)	
2ndrds Consumption Rate	X	Area Usage =	2ndrds Fuel Requirement

Total fuel requirement for a piece of equipment

EXAMPLE 1: Compute the fuel requirement for one day of operation given the following information:

Location: Korea

LIN	Nomenclature	Qty
T13374	Tank, Combat, M1	1

SOLUTION 1:

Step 1 -- Find Consumption rates

Table 2-12, page, 2-37 Idle/Avg = 10.8; Xctry = 56.6; 2ndrds = 44.64

Step 2 -- Find usage rates from table 2-14 for Korea: Idle/Avg = 5.2; Xctry 3.3; 2ndrds =3.4

Step 3 --Multiply the consumption factors times the usage factors

Idle/Avg: 10.8 X 5.2 = 56 gallons

Xctry: 56.6 X 3.3 = 187 gallons

2ndrds: 44.64 X 3.4 = 152 gallons

All three added together total: 395 gallons of diesel fuel.

EXAMPLE 2: Compute the fuel requirement for one day of operation given the following information:

Location: Conus

LIN	Nomenclature	Qty
J81750	Inf Fgt Veh Xm2	4
Z77257	M1e1 Tank, 120mm	4

SOLUTION 2:

Step 1 -- Find Consumption rates

LIN J81750: Table 2-12, page 2-30: Idle/Avg = 6.40; Xctry = 18.00; 2ndrds = 8.60

LIN Z77257: Table 2-12 Pg 2-52: Idle/Avg = 10.8; Xctry = 56.6; 2ndrds = 44.64

Step 2 -- Find usage rates from table 2-14 for Conus:

LIN J81750: Idle/Avg = 3.0; Xctry = 5.5; 2ndrds = 5.5

LIN Z77257: Idle/Avg =5.2; Xctry = 3.3; 2ndrds = 3.4

Step 3 -- Multiply the consumption factors times the usage factors

LIN J81750:

Idle/Avg: 6.40 X 3.0 = 19.2 gallons

Xctry: 18.00 X 5.5 = 99 gallons

2ndrds: 8.60 X 5.5 = 47.3 gallons

Total: 166 gallons of diesel fuel X 4 = 662 gallons

LIN Z77257:

Idle/Avg: 10.8 X 5.2 = 56 gallons

Xctry: 56.6 X 3.3 = 187 gallons

2ndrds: 44.64 X 3.4 = 152 gallons

Total: 395 gallons of diesel fuel X 4 = 1,580 gallons

GRAND TOTAL: 662 + 1,580 = 2,242 gallons diesel fuel

d. FCU Method -- Standard NATO agreement (STANAG 2115) mandates a standard Fuel Consumption Unit for the European theater. Equipment Usage Rates are standard:

(1) One hundred kilometers for vehicles.

(2) Twelve operational hours for equipment with a consumption rate in hours (with the exception of aircraft).

(3) Three flying hours for aircraft.

(4) Factors combat condition, terrain and climate into the fuel consumption rate

Combat	Terrain			Climate		
Attack	2.5	Flat	1.0		Hot	0.9
Delay	2.0	Hilly	1.2		Temperate	1.0
Defense	1.5	Mountain	1.5		Cold	1.3
		X-Country	1.5			

(5) Calculate the Fuel Consumption Unit as follows:

Combat Consumption Rate		Equipment Quantity		Usage Rate		Total gallons
	X		X		=	

(Table 3-1, FM 10-13)

Total Gallons		Combat Factor		Terrain Factor		Climate Factor		Fcu
	X		X		X		=	

EXAMPLE 1: Compute the fuel requirement for one day of operation given the following information:

LIN	Nomenclature	Qty
T39518	Trk Cgo Tact M977	2

Combat Condition: Attack
Terrain: Hilly
Climate: Hot

SOLUTION 1: Find consumption rate: Table 2-13, page 2-37 = 0.2672 gallons/Km

0.2672 X 100 X 2 = 53 gallons diesel fuel

53 X 2.5 X 1.2 X 0.9 = 143 gallons

EXAMPLE 2: Compute the fuel requirement for one day of operation given the following information:

LIN	Nomenclature	Qty
K31786	Helicopter, Uh-1b 7	
X58078	Trk Fuel Servicing	2

Combat Condition: Defense
Terrain: Mountains
Climate: Cold

SOLUTION 2: Find consumption rates:

JP4

Table 2-13, page 2-31 = 114.5 gallons/hr

114.5 X 3 X 7 = 2,405 gallons

2,405 X 1.5 X 1.5 X 1.3 = 7,035 gallons

MOGAS

Table 2-13, page 2-48 = 0.0621 gallons/Km

0.0621 X 100 X 2 = 12 gallons

12 X 1.5 X 1.5 X 1.3 = 35 gallons

e. CASCOM Pamphlet 700-2 Method determines unit requirements for company size units up to divisional strength. This method is based on 100 percent TOE strength and not modified (MTOE) configurations.

(1) Table 2-15 gives the Usage Profile based on location and/or type of unit.

(2) Table 2-15 also gives the consumption based on hours or KMs for each equipment type based on the Special Requirement Code for the unit.

(3) Multiply the Usage Profile data to the corresponding consumption data for the various equipment. Add the equipment category subtotals for the total unit requirement.

(4) Uses the Standard Requirements Code for each unit. Find parent unit first, then specific unit.

EXAMPLE 1: Compute the MOGAS requirement for one engineer battalion (SRC 05145H720) of an armored division (SRC 17000H020) for all categories of equipment using Korean profile - 073.

SOLUTION 1:

Step 1 -- Consumption Rates

AB	CE	GN	HG	MH	SG	SV	TI	CC	SR	WV	OV
40.0	4.5	24.0	49.2	0.0	81.7	0.0		0.0	0.1	0.0	

Step 2 -- Usage Profile

AB	CE	GN	HG	MH	SG	SV	TI	CC	SR	WV	OV
10	10	20	15	20	10	10	4.4	5.2	5.0	48.3	10

TOTALS:

400 + 450 + 480 + 738 + 817 + 4.83 = 2,889.8 = 2890 gallons MOGAS

f. Gallons per Person per Day method is used in the early planning stages, seldom below theater level and never below corps level. Data obtained give a starting point for further refinement.

(1) Troop strengths are obtained from:

(a) Personnel channels

(b) TOE/TDA

(c) FM 101-10-1

(2) Consumption rates

FUEL	EUROPE	PACIFIC	ALASKA	CANAL ZONE
MOGAS	1.5821	1.0606	2.4821	2.4273
DIESEL	5.9217	2.1566	2.6361	0.8738
JP4	2.2111	4.1830	7.8115	1.6991

EXAMPLE 1: Compute the petroleum requirement for two light infantry divisions operating in Honduras. Division strength is 10,762.

10,762 X 2 = 21,524 personnel

SOLUTION 1:

MOGAS:	10,762	x	2.4273	=	52,245 gallons/day
DIESEL:	10,762	x	0.8738	=	18,808 gallons/day
JP4:	10,762	x	1.6991	=	36,571 gallons/day

f. The OPLOG Planner is another aid to use to compile supply requirements.

(1) OPLOG Planner is a stand-alone program based on DBASE III; the program will compute requirements for multiphase operations using different intensities or profiles; the POL printout also shows vehicle fuel tank capacities which is useful for determining how often a unit would have to be resupplied. OPLOG Planner is not user friendly. The basic requirements to calculate the POL requirement are much more tan finding an SRC.

(2) The system requirements for OPLOG Planner are great. OPLOG Planner requires at least a 386 coprocessor wit 4 megabytes of RAM. Even with 4 Meg RAM, you have to create virtual memory in order to run OPLOG Planner. Instructions for this are include in the README file.

(3) OPLOG Planner Advantages:

(a) OPLOG Planner lists fuel tank capacities on the POL report. This enables logistics planners to determine not only how much fuel a unit requires, but how many times a day the unit must be resupplied.

(b) OPLOG Planner is a stand-alone program that can be loaded onto any suitable PC and run without any additional software support.

(4) OPLOG Planner Disadvantages:

(a) The major disadvantage to OPLOG Planner is that in order to run the POL report, there are several steps required. It makes the program somewhat tedious for new task organizations.

(b) A second disadvantage to OPLOG Planner is that it does require at least a 386 computer with 4 megabytes of RAM. Granted, today, this system is almost obsolete, but not all Army units have even this stage of technology.

g. Other services POL computations:

(1) U.S. Air Force.

(a) Air Force Pamphlet 144-4 lists all of the fuel consumption rates for Air Force aircraft and provides a basis for determining POL requirements.

(b) To calculate fuel requirements in this manner, the planner must know the type, quantity, and sortie duration in hours.

(c) To determine annual POL requirements at air bases, the Air Force uses historical data compiled by each base fuels flight.

(2) U.S. Marine Corps.

(a) The USMC Detachment Fort Lee, has developed spreadsheets for USMC equipment.

(b) The spreadsheets use consumption rates and usage factors similar to the Army's equipment consumption and combat profile methods.

(c) These spreadsheets were developed in Lotus for Windows and will not run properly on Excel.

(3) U.S. Navy. The Navy relies on historical data to develop their petroleum requirements for deployments of naval forces based on previous deployments.

LESSON 11

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. For only what is the Combat Profile Method used?

   A. Trucks.
   B. Combat tracked vehicles.
   C. Trailers.
   D. Infantry units.

2. Where does OPLOG Planner list fuel tank capacities?

   A. On the equipment report
   B. On the POL report
   C. On the deployment report
   D. In the warehouse

3. Which USMC Detachment has developed a spreadsheet for USMC equipment?

   A. Fort Polk Detachment
   B. Fort Stewart Detachment
   C. Fort AP Hill Detachment
   D. Fort Lee Detachment

LESSON 11

PRACTICE EXERCISE

FEEDBACK KEY

Item	Correct Answer and Feedback
1.	B. Combat tacked vehicles, (page 11-4, c.).
2.	B. On the POL report, (page 11-10, 3(a)).
3.	D. Fort Lee Detachment, (page 11-11, (2)(a)).\

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LESSON 12

JOINT DOCTRINE

Critical Tasks: 03-5103.00-0076
03-5103.00-0078
03-5103.00-0082
03-5103.00-0087
03-5103.00-0088
03-5103.00-0089
03-5103.00-0093
03-5103.00-0098
03-5103.30-1147
03-5106.00-0135

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will cover DOD agencies and their responsibilities in petroleum operations, the bulk petroleum concept of operations for developed and undeveloped theaters and operations other than war, the bulk petroleum planning procedures and considerations used during joint operations, and the bulk petroleum support for Joint Task Forces.

TERMINAL LEARNING OBJECTIVE:

ACTION: You will understand the DOD organizations used in joint petroleum operations; specific responsibilities of DOD organizations involved in petroleum operations; doctrine and petroleum concept of operations for developed and undeveloped theaters and operations other than war; petroleum planning procedures and planning considerations in joint operations; and petroleum planning and operations for Joint Task Forces.

CONDITIONS: You will use the corresponding lesson plan.

STANDARD: With at least 75 percent accuracy

REFERENCES: Joint Pub 4-03, FM 10-67, and MCWP 4-5.12.

INTRODUCTION

As a petroleum officer in a Joint Service environment, it is important hat you understand the doctrine, roles and missions of each service, and planning procedures for petroleum supply in joint operations. In this lesson, you will receive instruction that will serve as a guide for staff officers and bulk petroleum managers on planning and operating bulk fuel systems in a joint environment. Concepts and doctrine are presented to enable the planner to design a responsive petroleum supply system that will meet the needs of individual services and the theater mission as well.

1. Organization.

On 1 July 1973, DLA assumed centralized management of bulk petroleum within the DOD. The DESC was designated the IMM of U.S. military bulk petroleum. The CINCs have established JPOs to discharge staff petroleum logistics responsibilities within the theaters. Each military service is tasked with maintaining a petroleum office to manage bulk petroleum within the services. In this lesson, we will discuss the petroleum agencies throughout DOD. Each organization will be discussed separately.

NOTE: Figure 12-1 shows the DOD organizations involved in joint petroleum operations and planning.

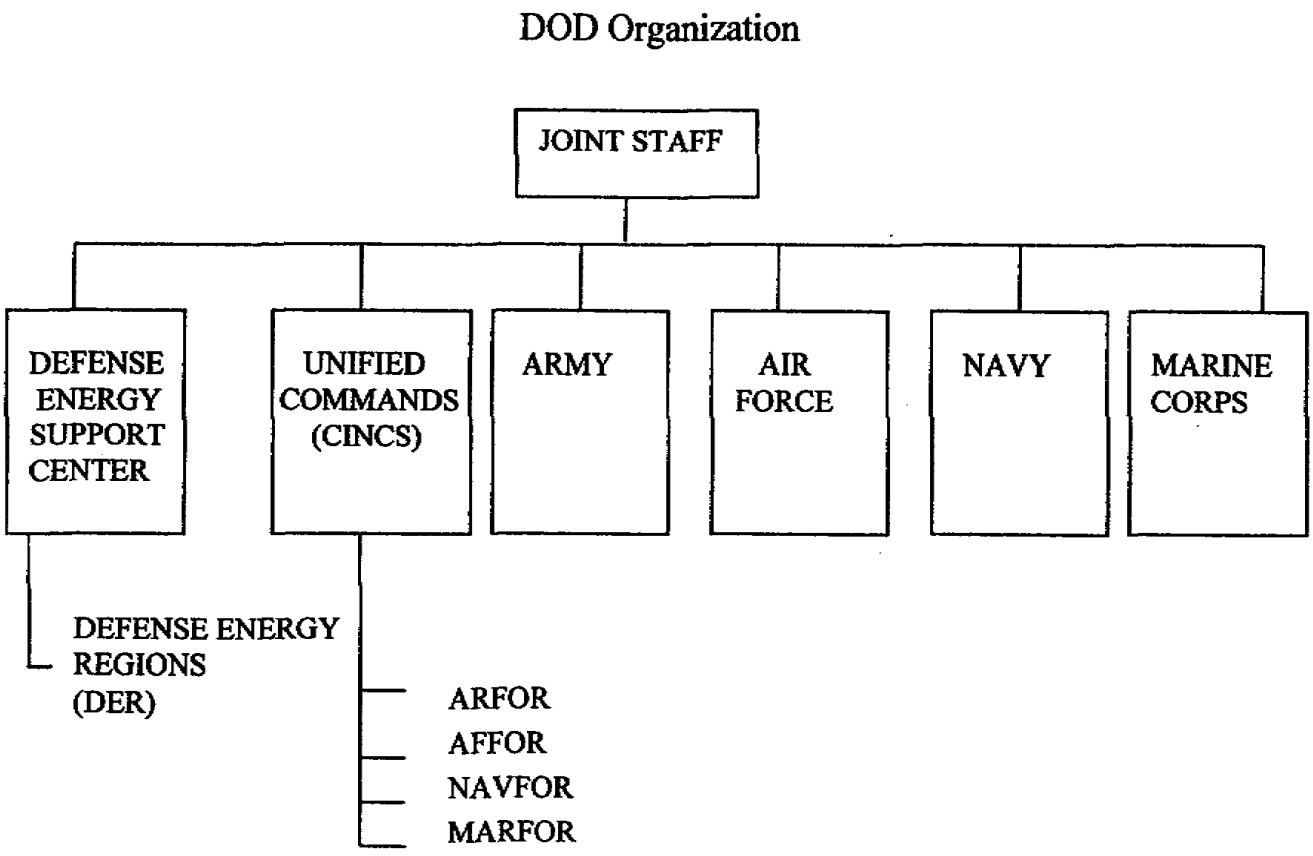

Figure 12-1.

a. Joint Staff. The Director for Logistics (J-4) Joint Staff is primary agent of the Chairman JCS to consider all bulk petroleum matters originating within, or referred to the Joint Staff.

b. Joint Staff Responsibilities. The joint staff J-4 acts as the focal point for bulk petroleum doctrine. Th joint staff develops definitive wartime bulk petroleum sourcing guidance for DOD. The J-4 prescribes procedures for reporting bulk petroleum data.

c. Defense Energy Supply Center. The DESC, a component of the DLA, is the DOD MM for bulk petroleum products. DESC is responsible for procurement of bulk petroleum products and related services until the product is delivered to the supported Service. To provide timely and efficient support to the services, DESC has set up area DERs. These regions provide close contact and coordination with the services. DERs are located in CONUS, the PACOM, the EUCOM, and Defense Fuel Region, Middle East. In CONUS, DERs order products from contractors, distribute products to the services, and perform contract administration. Overseas, DERs provide product ordering and contract administration. The missions and general functions of the DESC DERs are given in DOD 4140.25M, Volume I, Chapter 2.

d. DESC Responsibilities. The key functions of the DESC that impact on joint petroleum doctrine and operations are as follows:

(1) Act as the IMM for bulk petroleum products.

(2) Establish and maintain stocks at all wholesale DFSP.

(3) Coordinate with MSC for required tanker transportation for the movement of petroleum products.

(4) Acquire, in a contingency situation, the necessary petroleum products, storage, and/or services to support military requirements.

(5) Develop and publish the IMP.

(6) Publish petroleum tanker delivery schedules or slate, as required.

(7) Negotiate with foreign governments and international organizations for bulk petroleum products and facilities and any related services when it is determined by the CINC and the service components to be in the best interest of the DOD.

e. Unified Commands (CINCs).

(1) In unified commands, staff planning and management for bulk petroleum is performed in the J-4 JPO. The JPOs are normally staffed by personnel from each military service having a mission in the theater. The JPO coordinates the theater bulk petroleum operations and provides the interface between DESC and the service theater bulk petroleum managers. For the Army, this is usually the TAMMC. For the Air Force it is the Energy Management Division on the USAF component staff. For the Navy it is the Fleet Commander Petroleum Logistics Office, and for the Marine Corps it is the Marine component staff G-4. Service theater bulk petroleum managers provide service bulk petroleum requirements to the JPO. The JPO consolidates the requirements for all the services and schedules deliveries for the theater. The JPO advises the theater commander and staff on bulk petroleum logistic planning and policy matters. When required, the JPO advises the CINC on the allocation of bulk petroleum products and facilities. Bulk petroleum management for the entire theater is the ultimate responsibility of the commander of the unified command through the JPO. Daily management is done by the JPO in coordination with the services. The unified command may also establish SAPOs at the sub-unified command level to provide in-country or regional staff management functions.

(2) The JPO consolidates the delivery requirements for all components in the theater and forwards them to DESC. The monthly delivery requirement submission is called the petroleum slate. The JPO also coordinates the quality surveillance program within the theater.

f. CINC Responsibilities.

(1) Plan, manage, and coordinate the receipt, storage, and distribution of bulk petroleum products.

(2) Establish a JPO and appropriate SAPO to perform required missions.

(3) Provide petroleum logistic planning and policy guidance to component commanders.

(4) Coordinate resupply requirements of all of the service components within the unified command.

(5) Release or reallocate theater PWRMS.

(6) Coordinate the quality surveillance program within the unified command.

(7) If required, allocate petroleum stocks and facilities in the area of operations.

(8) Submit requirements to host nations for the performance of HNS petroleum support

(9) Identify and coordinate the joint mission essential and key tasks required for component bulk petroleum units to meet the needs of regional OPLANS and contingency plans.

2. Army.

a. The U.S. Army staff management for petroleum planning and operations is in the Army Energy Office, Office of me Deputy Chief of Staff for Logistics. Daily operational supply of bulk fuel in the Army is managed by the USAPC. Principal duties of the USAPC include determining and consolidating Army fuel requirements, submitting procurement requests to DESC, and maintaining liaison with DESC and other military services on operational and policy matters affecting bulk fuel operations. At the Army theater level, the TAMMC is the item manager for bulk fuel. In accordance with DOD 4140.25, the Army provides overland bulk fuel support to U.S. land-based forces of all the services. The Army organization responsible for carrying out the inland distribution mission is the petroleum group. The petroleum group is responsible to the unified commander or the detailed planning and support of all component Services. To perform this task, the petroleum group will use available military, commercial, and host nation assets.

b. The Army is tasked with the mission of providing overland theater level bulk fuel support to U.S. land forces of all overseas DOD components except Navy ocean terminals. This mission includes providing the necessary force structure to construct, operate, and maintain overland pipelines in support of the wholesale theater bulk fuel mission. In areas without an Army presence, either the dominant user designated by the joint commander, DESC (by contract), or a combination of both will be tasked to operate the bulk fuel distribution system.

3. Air Force.

Staff management responsibility for U.S. Air Force bulk fuel is in the Fuels Policy Branch, Deputy Chief of Staff Logistics and Engineering. Air Force Fuels Division Detachment-29 is the control point for bulk fuel requirements and inventory management. It conducts liaison with DESC and the other services on operational and policy matters affecting bulk fuel operations. At the Air Force major command level, the Command Fuels/Supply Officer provides staff and command supervision over bulk fuel operations. In-flight refueling operations are not considered bulk fuel operations and are the responsibility of the Air Mobility Command (AMC). Organizations requiring in-flight refueling support should coordinate directly with AMC.

4. Navy.

Department of the Navy staff management for bulk fuel is in the Navy Energy Office, Deputy Chief of Naval Operations, Logistics. The Navy Petroleum Office (NAVPET) is the control point for bulk fuel requirements and inventory management. NAVPET duties include maintaining liaison with DESC and the other services on operational and policy matters affecting bulk fuel operations. At the Navy major command level, fleet petroleum staff officers provide staff management on bulk fuel matters. In joint operations, the Navy supports the ship-to-shore bulk fuel mission. The Navy is responsible for getting bulk fuel to the beach high water mark where the fuel is received by Army or Marine Corps bulk fuel units. The Navy's shore fuel expeditionary mission is filled entirely by Naval Reserve fuel units. These units are managed by NAVPET and the expeditionary support force. They are composed of 22-man units, capable of handling multiple missions including bulk and retail bag farm operations, truck, aviation refueling, OPDS, and augmentation of fixed fuel facilities. There were 10 units in existence as of 1994, equally distributed on both coasts.

5. Marine Corps.

Headquarters Marine Corps policy responsibility for bulk fuel resides in the Material Policy Section (LPP-2), Deputy Chief of Staff for Installations and Logistics. NAVPET is also the Marine Corps service control point for bulk fuel. At the major command level, the Marine component commander and/or the MEF assistant chief of staff G-4, is responsible for bulk fuel management, planning, operations, and policy. The Marine component commander/MEF G-4 maintains liaison with the unified command JPOs, NAVPET, and the other military services on matters concerning bulk fuel operations and policy.

6. Military Services Responsibilities.

NOTE: The following actions apply to all the services in the theater.

a. Maintain an SCP for bulk petroleum.

b. Provide for the operation of retail petroleum facilities under service ownership.

c. Compute bulk petroleum requirements and submit requirements to DESC or the appropriate CINC.

d. Standardize bulk petroleum operating procedures and supply organizations as required and feasible.

e. Ensure total interoperability among services of all petroleum product containers and handling equipment.

f. Comply with DOD Manual 4140.25M and Military Handbook 200 in the development and execution of a quality surveillance program.

g. Establish petroleum testing capabilities to support service requirements.

h. IAW DOD Directives 4140.23 and 4220.7, plan, program, and budget to reduce the number of bulk petroleum products that must be stocked by the military logistics system.

i. Promote/implement the single fuel on the battlefield concept.

j. Organize train and equip fuel support forces.

7. Individual Service Responsibilities.

a. Army - develop and maintain equipment to support the overland distribution of bulk petroleum to all services.

b. Navy - in an undeveloped theater, provide for the delivery of bulk petroleum to the high-water mark for all services.

c. All - maintain a capability to provide bulk petroleum support to service units.

d. In support of joint operations, provide the theater manager or designated predominant service with any specific general support requirements.

8. Concept Of Operations.

a. Bulk fuel support is a joint venture. While bulk fuel management for joint operations is the ultimate responsibility of the commander of the joint command, each service is responsible for support of its forces and any other missions assigned by the joint commander. The actual procedures used to provide bulk petroleum support to the services will depend on conditions in the area of operations.

(1) Developed Theater. A mature or developed theater will usually have host nation assets available such as pipelines, storage facilities, and railways that will help support the bulk petroleum distribution system. Airbases, tactical airfields, and service bed-down sites will be supported by pipelines whenever tactically feasible. The pipeline and/or hose line system will extend as far forward as possible.

(2) Undeveloped Theater - In the undeveloped theater, host nation or commercial bulk fuel facilities normally will not be available and tactical assets will have to be used. The bulk fuel supply system in the undeveloped theater may include limited tanker mooring systems, floating hose lines, submarine pipelines, inland tank farms, hose lines, and collapsible tanks.

b. Joint petroleum operations are not new. Bulk petroleum logistics has been a joint operation for over two decades. Our concepts depend on whether we are operating in a developed or undeveloped theater. Regardless of the type of theater, the CINC has the predominant fuel responsibility within the theater. While each service is responsible for direct fuel support to its forces, they coordinate fuel issues with the CINC JPO and DESC during joint operations. The main purpose of this coordination is to ensure efficiency and avoid duplication of effort.

c. Theater-wide petroleum management is the ultimate responsibility of the CINC through the JPO. The day-to-day management of petroleum support is done by the JPO through coordination with the services, DESC, and allied/host nation support. Using recommendations and advice from the services, the CINC is the final determinant of the appropriate way to do the petroleum mission to include the proper mix service tactical equipment, DESC contract support, and host nation agreement.

d. The following concepts may be modified to do command unique missions.

(1) Each service is responsible for providing retail bulk petroleum support to its forces.

(2) Retail petroleum is that held primarily for direct support to the end-user; for example, aircraft and vehicles.

(3) When overseas, the Army is normally charged with the mission of providing overland petroleum transportation support of all U.S. land-based forces.

(4) In areas without an Army presence, either the dominant user, DESC, or a combination of both will operate the petroleum distribution system.

e. The wholesale or general support bulk petroleum distribution system is a push-pull resupply system. Customers request fuel from direct support organizations. At the same time, scheduling movement of product forward in the general support system is based on the combination of storage space available and anticipated storage space based on projected customer demands. The basic concept is to keep storage tanks full at all times. Bulk reduction is done as close to the customer as practicable to reduce transportation requirements.

(1) When demand exceeds availability, the petroleum group commander will recommend an allocation system, based on priority, to support the theater plan of operations. The allocation system must be approved by the CINC.

(2) Petroleum doctrine recognizes the differences between developed and undeveloped theaters

9. Concept of Operations Developed Theater.

Current doctrine for petroleum support recognizes the differences in requirements imposed by both the developed and undeveloped theaters. The developed theater will normally have host nation assets that will augment the military bulk petroleum system. The capabilities of allies to support or interface with bulk petroleum facilities and stocks is theater-unique. The JPO will integrate any allied capability into the operational plans and will use allied/host nation support to augment U.S. capabilities. The following capabilities are normally available in the developed theater.

a. Tanker loading/unloading facilities

- Base terminals.
- Intermediate terminals.
- Head terminals.
- Pipelines.
- Pump Stations.
- Dispensing facilities.

b. A theater is a geographical area in which a unified command conducts military operations. A developed theater has a COMMZ and a combat zone. The COMMZ is the rear part of the theater behind the combat zone, that contains the lines of communications, establishments for supply, and other agencies required for the immediate support and maintenance of the field forces. The combat zone is the area required by the combat forces for the conduct of operations.

c. The Bulk petroleum distribution system in a developed theater includes discharge facilities, which include tanker moorings, piers, docks, sea terminals, inland tank farms, and other petroleum facilities. It also includes pump stations and pipelines.

NOTE: See Figure 12-2.

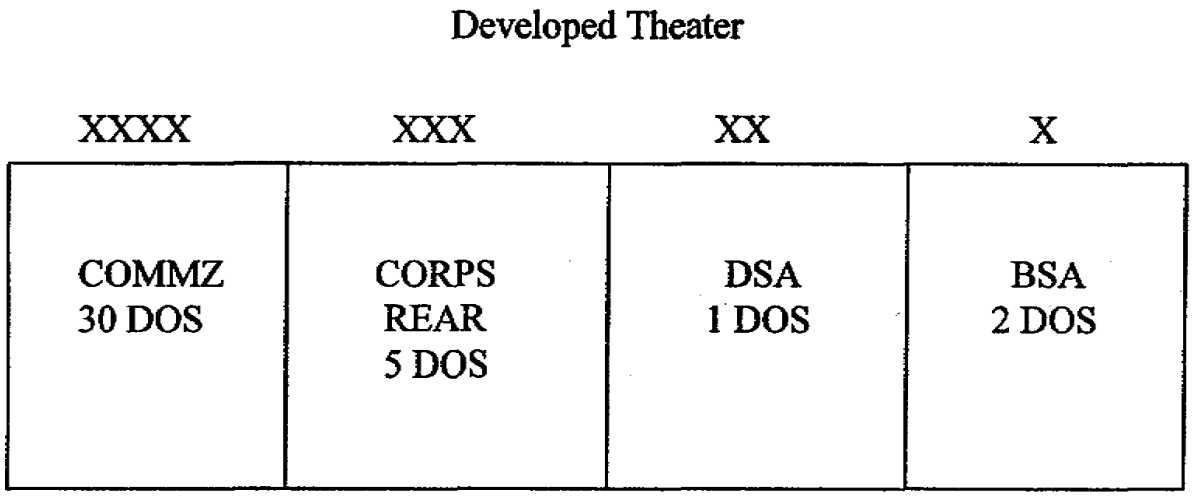

Figure 12-2.

10. Concept of Operations Undeveloped Theater.

a. Providing bulk petroleum support in an undeveloped theater presents many problems not faced in a developed area. Host nation assets may be limited or not available. The entire system and stocks have to be brought in and installed. The bulk petroleum system must be developed in the objective area as soon as practical. Initial petroleum facilities must then be expanded as soon as possible so that floating storage assets may be released. Use of military tactical ship-to shore and petroleum storage and distribution equipment will be required to support the theater.

NOTE: See Figures 12-3.

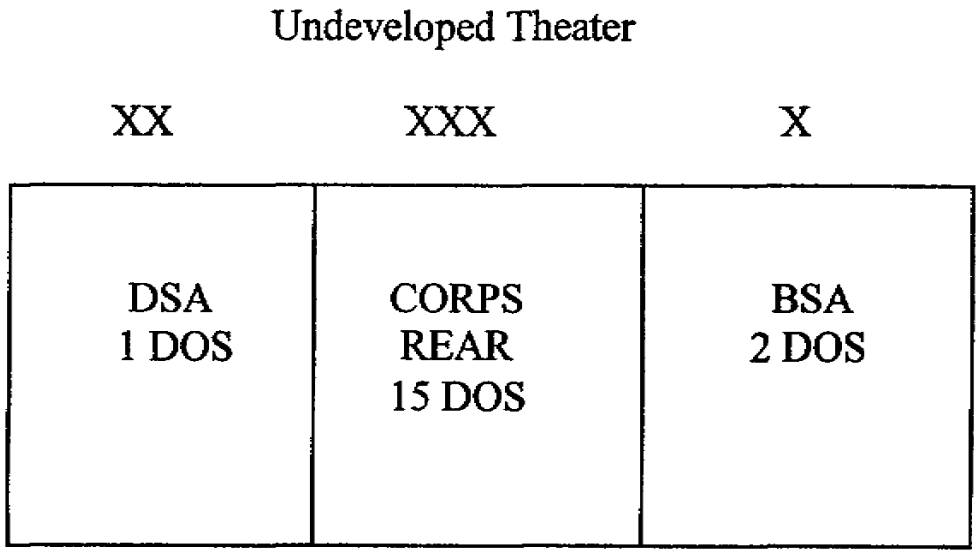

Figure 12-3.

b. Assault hose lines will be used to move fuel from ocean terminals to forward support bases and airfields. The hose line will extend as far forward as possible into the Corps rear area. The system will be expanded as required to provide the support for the theater concept of operations. The petroleum system in the undeveloped theater should provide, if possible:

(1) Enough storage capacity to unload within 24 hours the complete cargo of the largest tanker that is scheduled.

(2) Enough reserve operating capacity to receive and issue petroleum at the same time.

(3) Enough storage capacity to allow fuel received to settle at least 24 hours before it is pumped through the system.

(4) Laboratory facilities for quality surveillance operations.

11. Concept of Operations Supply Levels.

The major portion of the theater level is maintained in the COMMZ. The unified commander (NO) prescribes supply levels for the theater in terms of days-of-supply. The service components prescribe levels for their forces in the COMMZ and the combat zone. Supply levels must take into account the requirements of all services in the theater.

a. Concept of Operations Supply Levels Developed Theater. For planning purposes only, a minimum of a 30-day theater supply level should be set up for bulk petroleum in a developed theater. In actual practice, this level may be greater than 30 days depending upon available tankage and other factors.

b. Concept of Operations Supply Levels Undeveloped Theater. For planning purposes only, a minimum of a 15-day supply level should be set up in the theater. The major portion of the theater level is maintained in the CSA. Again, supply levels must take into account the requirements of all service components.

12. Concept of Operations Operation Other Than War (OTW).

There are special considerations during operations other than war.

a. Minimize the logistics footprint.

b. Increase reliance on in-country civilian or host nation support.

c. Establish contracts early with fuel supplies.

d. Tailor fuel equipment and support packages to the requirement and mission.

e. Ensure service compatibility.

13. Joint Planning.

a. Planning for bulk fuel support can be a complex and challenging task. Time, space, distances, terrain, resources, and the operating environment are all planning factors that have to be considered. There are six major elements of bulk fuel planning: Requirements, sourcing and procurement, transportation, sage, distribution, and equipment.

b. The supported CC and/or the joint commander is responsible for the overall planning of bulk fuel logistical support. The unified or joint command plan is the basis for all subordinate bulk fuel support plans. This plan establishes concepts, objectives, assigns missions, and allocates available resources. Operation plans submitted to the joint staff will include a petroleum appendix to the logistics annex in the format prescribed in Joint Pub 5-02.2, JOPS, Volume II (see Appendix A). The service components develop a bulk fuel support concept based on the tactical plan.

Once the concept is approved by the joint commander, the service components then prepare the implementing bulk fuel support plan. During operations, the joint staff and the service bulk fuel planners revise the basic plans as required to support the mission.

c. Planning for joint operations:

(1) The supported CINC is responsible for the overall planning of petroleum logistic support within the theater.

(2) Operation plans submitted to the CINC will include a petroleum appendix to the logistic annex in the JOPS format.

(3) The CINC uses the JSCP as their guide in preparing theater OPLANs and logistic support plans.

(4) The service components first develop a petroleum support concept based on the tactical plan and joint doctrine.

d. Planning the system:

(1) The service components then prepare the implementing petroleum support plan.

(2) Petroleum support plans are flexible and will be revised as the situation requires.

(3) Theater petroleum planning must be coordinated with all components.

(4) The theater inland petroleum distribution plan is prepared by the Army Petroleum Group or the designated dominant service and is an annex to the theater logistics support plan.

(5) This level of planning produces the IPDP and base support plans.

(6) Bulk fuel planning falls into two basic categories.

(a) Logistical Planning. Logistical planning involves determining specific fuel requirements and distribution plans based on factors such as fuel consuming equipment, mission, terrain, and climate. Logistical planning is started well in advance of actual operations. The primary purpose of this type of planning is to ensure that fuel products, equipment, bulk fuel operating units, and host nation or commercial support will be available when needed.

(b) Operational Planning. Operational planning includes planning for reaching the required capacity of the bulk fuel supply system and for maintaining the

and during operations. Operational planning has to be flexible and allow for changes due to tactical developments, losses in fuel stocks and equipment, and other factors that may keep the system from operating as planned.

(7) Planning considerations:

(a) The mission and force to be supported.

(b) The capability of installations and/or units to provide the required support.

(c) The speed with which pipelines and hose lines can be installed and made operational.

(d) Petroleum supply planning falls into two basic categories.

(e) Proper mix of petroleum units.

(f) Ship-to-shore requirements.

(g) Tactical system requirements.

(h) Host Nation support.

(i) Distribution methods to be used.

(j) Planning elements to consider:

- Time phased requirements by location.
- Procurement.
- Storage and distribution points required.
- Transportation mode.
- Equipment to be used (rail, truck, barge, pipeline).
- Organizations/units required to operate the system.

14. Joint Task Forces.

The unified commands or CINCs are assigned a geographical area as mentioned earlier. However, for specific missions, the CINCs will often assemble a JTF. Normally, the joint task force logistics staff officer for petroleum will rely on the area CINC JPO for wholesale bulk petroleum management. The JTF petroleum staff officer is responsible for:

a. Coordinating POL planning and mission execution matters with the service components.

b. Coordinating the supply of common bulk petroleum and packaged POL to the JTF components.

c. IAW DOD 4140.25M, coordinate with the component services in determining requirements for bulk petroleum that must be obtained from in-country commercial sources and submit these requirements through the CINC JPO to the applicable DER procurement office.

d. Recommend necessary allocation and apportionment of bulk petroleum products, and facilities to COMJTF.

e. Coordinate quality surveillance and procurement programs.

NOTE: When JTF operations warrant extensive management of wholesale petroleum products in the JTF area of operations, the JTF J-4, in coordination with the area JPO, may set up a SAPO. Staff augmentation for the SAPO will come from the service components.

LESSON 12

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. In what year did DLA assume centralized management of bulk petroleum within the DOD?

   A. 1963
   B. 1973
   C. 1983
   D. 1993

2. Which service's mission is to provide overland theater bulk fuel support to U.S. land forces of all overseas DOD components except Navy ocean terminals?

   A. The Navy
   B. The Army
   C. The Marines
   D. The Air force

3. Into how many categories does bulk fuel planning fall?

   A. One (Operational)
   B. One (Logistical)
   C. Two (Operational and Logistical)
   D. Bulk fuel planning is not divided into categories.

LESSON 12

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	B. 1973, (page 12-1, para 1).
2.	B. The Army, (page 12-5, para 2b).
3.	C. Two, (Operational and Logistical), (page 12-11, para 13b).

LESSON 13

MILITARY CONSTRUCTION PROJECTS

Critical Task: 03-5103.00-0087
03-5103.00-0090
03-5103.00-0093
03-5103.00-0098

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn about military contracts, the role of the DESC in relation to military contacts, how to prioritize projects, the importance of considering environment and what a contracting cycle is.

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe the role of DESC in MILCON projects, discuss the MILCON mission, describe project prioritization, describe the importance of environmental considerations in MILCON projects and describe the MILCON cycle.

CONDITIONS: Given this lesson and DOD Manual 4140.25M.

STANDARDS: With at least 70 percent accuracy IAW DOD Manual 4140.25-M.

REFERENCES: DOD 7420.13-R, DOD 4140.25-M, and DLAM 4270.1.

INTRODUCTION

As a petroleum officer, you can be assigned to a position in which you will have to oversee a military construction project to upgrade or replace existing petroleum facilities, or initiate the construction of a new facility. As such, you need to be familiar with the military construction mission of the Defense Energy Supply Center, which is responsible for the construction of all military bulk fuel storage facilities.

1. MILCON Mission.

Military Construction (MILCON): A military construction project is a single undertaking at a military installation that includes all construction necessary to produce a complete and usable facility at an approved cost equal to or greater than the amount specified by law (currently more than $300,000). There are several categories of MILCON projects, such as:

a. Current Mission MILCON: These projects revitalize the existing facility plant by replacing or upgrading existing facilities, and by alleviating long-standing deficiencies not generated by new missions.

b. Incidental MILCON in support of New Mission: Upgrades of a fuel facility which are part of a larger conversion or other service initiative are to be funded and done by the service as part of the larger initiative. For example, if extensive facility construction is required in conjunction with a new base, part of which is the associated fuel facilities, the fuel facilities construction will be programmed and executed by the service as part of the overall MILCON for the new base.

c. Unspecified/Urgent Minor MILCON: Unspecified minor construction authority is to be used for projects which require accomplishment sooner than would be possible if delayed for inclusion in the next regular MILCON program. These projects fall in the fiscal range of greater than $300,000 but less than $1,500,000.

d. Environmental MILCON: MILCON projects with one or more environmental improvement projects combined to satisfy environmental compliance objectives.

e. Minor Construction: This is the counterpart to MILCON for projects with smaller dollar amounts. A minor construction project is a single undertaking at a military installation that includes all construction necessary to produce a complete and usable facility or a complete and usable improvement to an existing facility, with a total cost less than the specified MILCON threshold authorized by law (currently equal to or less than $300,000).

2. Role of DESC in MILCON Projects.

a. In October of each year, DESC calls for MILCON submissions for a 5-year FY period beginning 5 years from the fiscal year in which the data call occurs. This is known as the 5-Year Defense Plan. For example, in October 1993, DESC's data call required MILCON submissions for the 5-year period FY98-02 which includes the program year of FY 98.

b. In the following February, CINC-JPOs and SCPs (for example, the Army Petroleum Center), determined to be the appropriate component review/approval chain, will review validate projects and develop consolidated project priority lists.

c. In the following March, CINC-JPOs and SCPs will forward candidate POL MILCON projects and consolidated project priority lists to DESC.

d. From March to May, DESC reviews and validates all candidate MILCON projects submitted by the SCPs and CINC-JPOs in conjunction with DESC's own candidate projects.

e. In May, DESC formulates a proposed "slate" of POL MILCON projects for consideration at the DESC IPRB and will notify the SCPs and CINC-JPOs concerning the status of the proposed slate.

f. In July, the DESC IPRB will meet to review, endorse, and prioritize projects for submission to DLA. The Board includes representatives of JCS, CINC-JPOs, Service energy offices, and DESC representatives who vote ad formulate the consolidated slate of proposed projects.

g. From August to the following April, DLA will review and endorse or reject the DESC project submission as part of DLA's presentation of projects to DOD for further submission to Congress for review, approval/rejection, and funding, if applicable.

h. Congress is the ultimate approval authority for MILCON projects. Under its 5-Year Defense Plan, Congress takes in revenue in the form of taxes, then approves spending for the Department of Defense over this five-year time span, and votes to appropriate levels of funding for DOD projects. The 5-Yea Defense Plan encompasses not only MILCON, but everything else associated with DOD, including weapons system procurement; soldier/sailor pay; base housing; operations and so on.

3. Project Documentation.

Each project must be thoroughly researched and documented because it will compete with other projects at the DESC IPRB, the DLA IPRFP, and various OSD and Congressional level reviews. Guidance for project documentation is contained in DLAM 4270.1. Documentation includes:

a. DD Form 1390, Military Construction Program for each installation.

b. DD Form 1391, Military Construction Project Data.

c. Facilities Study.

d. The economic analysis must either justify the project solely on the basis of economics, or demonstrate the lowest cost alternative in order to fulfill operational requirements. DESC recommends the use of ECONPAK software, available at no cost from the US Army Corps of Engineers, Huntsville District. To obtain, call (205) 895-3363, DSN 788-3363, fax (205) 895-3437, DSN 788-3437, or write:

Commander
USAED-Huntsville
PO Box 1600
Huntsville, AL 35807-4301

e. The Scope and Detailed Cot Estimate must be verified by cognizant Corps of Engineers of NAVFAC Engineering Field Division, NAVFAC Public Works Center, Air Force Base Engineering Function (using AF Form 1178), or activities Public Works Departments.

4. Project Prioritization.

a. To assist in assessing the relative importance of projects within a given funding program, all correspondence must include a prioritized list of projects being submitted. DESC will consider each project's content and the submitter's justification, and develop a consolidated priority list containing all projects proposed for a given fiscal year. DESC will provide the Service/Major Command/CINC-JPO a copy of the MILCON project priority list following the DESC IPRB and again following the DLA IPRFP with the estimated funding cut-off indicated.

b. The following criteria should be used to develop a justification statement; these criteria are not necessarily listed in priority order:

(1) Mission Essential--the activity cannot or will not, by a specific date, be able to perform its fueling mission.

(2) Required to comply with environmental, safety, fire protection, or other regulations or laws--the specific regulation or law being violated must be specified and synopsized as part of the justification.

(3) Protection of product from loss or contamination--the justification should address how the project will protect DLA product and contamination loss.

(4) Economic payback--the project will result in an economic payback in a specified period of time.

(5) Directed by DLA/DESC or other higher authority.

(6) Efficiency of operation must be improved.

5. Project Eligibility for DLA/DESC Funding.

For a project to be eligible for DLA/DESC sponsorship for a MILCON project, it must directly support the DLA bulk petroleum management mission. Only fixed, permanent facilities will be eligible for DLA/DESC MILCON project funding.

6. Importance of Environmental Considerations.

Environmental compliance for POL facilities is defined by the following criteria:

a. Design and construction of pollution abatement projects. DLA/DESC will fund projects to upgrade POL facilities to control emissions and discharges to meet environmental regulatory standards. Also included are projects needed for POL facilities to achieve regulatory compliance to continue to operate.

b. POL waste site assessment and cleanup. DLA/DESC will fund the identification, assessment, and remediation costs of fuel spills/leaks which occur after 1 October 1992. All past POL contamination sites resulting from activities conducted prior to that date will remain a service funding responsibility.

c. Recurring environmental costs to maintain POL facility compliance. This includes operating permits, operational documents, sampling and testing of emissions and discharges, removal and disposal of hazardous and other POL wastes, and fines and penalties levied by regulatory agencies for environmental noncompliance of bulk petroleum facilities previously identified by the services to DESC and for those conditions beyond the control of the services, unless such fines or penalties result from a lack of timely action by the services.

LESSON 13

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What is the minimum dollar threshold required for a MILCON project?

   A. $3,000
   B. $30,000
   C. $300,000
   D. $300,000,000

2. How many fiscal years worth of MILCON projects does DESC solicit each fiscal year?

   A. 5
   B. 7
   C. 9
   D. 11

LESSON 13

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	C. $300,000 (Page 13-2, para 1e).
2.	A. 5 (Page 13-2, para 2a).

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LESSON 14

WATERFRONT AND TERMINAL OPERATIONS

Critical Task: 01-5103.30-2045
03-5103.00-0076
03-5103.00-0087
03-5103.00-0091
03-5103.00-0093
03-5103.00-0096

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn to initiate supply actions to obtain and issue petroleum and water products. You will also learn how to supervise petroleum terminal operations, plan petroleum and water supply programs in the Theater of Operations, supervise petroleum waterfront operations, plan petroleum and water distribution system (fixed facility), and manage a' petroleum and water supply point operation.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify waterborne petroleum carriers, waterfront terminal terms, petroleum loading procedures, and petroleum unloading procedures.

CONDITIONS: Given FM 10-67-1 and the accompanying lesson plan.

STANDARDS: IAW FM 10-67-1.

REFERENCES: FM 10-67-1

INTRODUCTION

More than half the tonnage handled in the military is petroleum. To do your job, you must know the responsibilities and procedures for loading and unloading petroleum tankers and barges. Until bulk petroleum products are consumed, they must be handled many times. Accurate receipt, storage, issue, and shipment of petroleum products must be maintained. As a petroleum manager, your duties will require supervising and reviewing procedures.

1. Military Sealift Command.

a. The primary mission of the MSC controlled tanker fleet is to provide worldwide transportation for the delivery of petroleum products from refineries to DOD storage facilities. The tanker fleet consists of approximately 30 tankers, which vary in size from 27,000 to 38,000 tons.

b. There are three types of contracts.

(1) Bareboat charter. The tanker is leased to MSC; MSC personnel crew the ship and are responsible for all expenses.

(2) Time charter. From a few weeks to a number of years, the owner provides the crew and pays all expenses.

(3) Single voyage charter. The ship is leased for a single voyage, and the owner is responsible for the crew and all expenses.

c. There are two types of service.

(1) Dirty service--for heating oils and crude service.

(2) Clean service--for finished products only. Ships cannot carry split cargoes without prior approval from the DESC.

2. Terms.

a. Bow. Front end of the vessel.

b. Stern. Rear end of the vessel, also called the "aft section."

c. Midships. Center of the vessel.

d. Port. The left side of the ship when standing midships and facing the bow.

e. Starboard. The right side of the ship when standing midships and facing the bow.

f. Deadweight tonnage. The carrying capacity of a tanker in long tons of 2,240 pounds.

g. List. When the vessel leans to the port or starboard.

h. Trim. When the vessel is level in the water and plumb. The vessel is trim for voyage when it is slightly down in the stern.

i. Sagging. When the vessel is loaded heavily midships.

j. Hogging. When the vessel is loaded heavily on the bow and stern with nothing midships.

3. Barges.

a. Self-propelled. These barges move under their own power and are used in inland and coastal waterways. They must maintain a crew at all times.

b. Nonself-propelled. They must be moved by tugboats and can be used for temporary storage. They are equipped with their own pumping system.

4. Pumps.

Most tankers have two pumping systems.

a. Centrifugal pumps for off-loading the cargo.

b. Gear or piston pumps for stripping the cargo tanks dry.

5. Ship Tanks ad Manifolds.

Most tankers have the capability to carry up to five different products. Ship tanks are arranged abreast ad numbered from bow to stern.

NOTE: The instructor will point out the manifold ad numbering system using the viewgraph.

6. Waterfront Facilities.

a. Multileg mooring systems.

b. Single point mooring systems (mono buoy).

c. Jetties: Jetties are used when the water depth or the shore line is unsuitable for bringing in tankers.

d. Docks and Piers: Docks or pier are the most secure for unloading tankers.

(1) Security is easier to maintain.

(2) Access to the tanker is easier in case of emergency and for maintenance.

(3) They are protected from winds and tide.

(4) The depth should have at least 10 feet of water under the biggest tanker you expect to receive fully loaded at mean low tide.

(5) Should be separated from other classes of supply.

7. Equipment Requirements.

The following equipment should be available:

a. Minimum of two storage tanks for each product and ballast water.

b. Oily water separator for the treatment of ballast water.

c. Fire-fighting equipment -- portable fire extinguishers and an engineer fire-fighting detachment.

d. Pollution control equipment -- skimmer boats, sorbent materials, and containment booms.

e. Communications has to be from the dock to the ship and to the tank farm.

f. Ground transportation and workboats for transporting men and equipment to the tanker.

g. Grounding system -- form bonding the ship to the dock. If the dock has a cathodic protection system, it should be turned off before the transfer of fuel begins.

h. A base laboratory for testing the products.

8. Preparation for Arrival.

a. Tanker Arrival Schedule. The tanker arrival schedule is checked to ensure the type and quantity of product is known.

b. Personnel Required. Personnel required to meet the tanker and go aboard in the harbor: terminal representative, lab tech and customs official, if required.

c. Berthing Facilities. Make sure the area is cleared for the tanker to tie up.

d. Cargo Hose/Loading Arms. The loading arms will be checked and maintenance performed. If hoses are to be used, they will be pressure tested and the flanges checked.

e. Shore Tanks and Manifolds. Tanks are gaged and sampled, and product transferred to create ullage if required. All pipelines and manifolds are checked and packed with product to the dock.

f. Pumps and Gages. Maintenance is performed on all pumps, and all gages are checked.

g. Communications. All communications are checked from the dock to the vessel and to the tank farm.

h. Pollution Control Equipment. Booms and skimmer boas are made ready to be deployed.

i. Fire-Fighting Equipment. Portable fire extinguishers are placed at all critical locations.

j. Terminal Commander. The terminal commander is responsible for all operations starting at the ship's manifold.

(1) Pipeline patrol.

(2) Hose watch.

(3) Shift changes.

k. Shipboard Actions. The master of the vessel is responsible for all shipboard actions.

l. Paperwork:

(1) Tanker activity report. The tanker activity report is used as a worksheet to fill out the DD Form 250-1.

(2) DD Form 250-1.

9. Unloading.

a. Valve Seals. Prior to the valves being unloaded, the valves aboard the vessel are checked to ensure they have been sealed, and the seal numbers have been recorded on DD Form 250-1.

b. Pumping. For JP-4, pumping will commence at a reduced flow rate not to exceed 3 feet per second until the fill line in the tank is covered with fuel.

c. Delays. Any delays will be recorded in the time section of DD Form 250-1. This may determine who pays demurrage.

d. Stripping. Once the centrifugal pumps lose suction, the stripper pumps are brought on line and the tanks are pumped dry.

e. Completion of Off Loading. When the ships tanks are empty, they are inspected by terminal personnel and a dry tank certificate is issued. If product is found in a tank and cannot be removed, that fact is recorded in the remarks section of the DD Form 250-1.

f. Gaging of Shore Tanks. After the proper settling time, the shore tanks are gaged and the amount is recorded on the DD Form 250-1. If the amount received is less than that recorded on the DD Form 250-1 as loaded and the shortage is more than one half of one percent, it will require an investigation by the applicable DESC fuel region upon receipt of the DD Form 250-1. For this reason, the inventories and the submission of the paperwork must be done as soon as possible.

g. Departure. After the tanker has departed, the pier is cleaned up and made ready for the next operation.

10. Loading Procedures.

a. As soon as the vessel is docked the terminal commander or his representative should check the cargo to determine which product will be loaded first. This action will be mutually agreed upon.

b. The shore ballast tanks should be checked to ensure that enough ullage is available to except ballast from the tanker.

c. The ship's tanks should be checked to ensure they are clean and free of ballast and suitable for receiving product.

d. For pumping; follow the same procedures as for unloading.

e. When tanks are 90 percent full, reduce the pumping rate to avoid spills or overflow.

f. Conduct follow-up procedures. Allow enough time for tanks to settle before gaging each tank. Calculate the quantity loaded.

g. Obtain an all-levels sample from each compartment and run a Type “C” test according to MIL-HDBK-200.

h. Gage shore tanks and compare quantities pumps with quantities received.

i. After the product quality and quantity has been determined, check and seal all hatches, seal valves and crossovers, and record all seal numbers on the DD Form 250-1.

LESSON 14

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What is the front end of a vessel known as?

   A. Stern
   B. Bow
   C. Port
   D. Starboard

2. What is checked to ensure the type and quantity of a product is known?

   A. Tanker arrival schedule
   B. Pumps and gages
   C. Valve seals
   D. Transportation

3. The shore ballast tanks should be checked to ensure that enough ullage is available to except ballast from the tanker. What type of procedure is this?

   A. Unloading Procedures
   B. Ship Procedures
   C. Loading Procedures
   D. Checking ship

LESSON 14

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	B. Bow, (Page 14-2, para 2a).
2.	A. Tanker arrival schedule, (Page 14-4, para 8a).
3.	C. Loading Procedures, (Page 14-6, para 10b).

LESSON 15

INTERNAL CORROSION

Critical Tasks: 01-5103.30-2123
03-5103.00-0078

OVERVIEW

LESSON DESCRIPTION:

In this lesson, we will discuss how corrosion occurs in the storage and handling system, as well as methods to control it.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify internal corrosion causes/effects and methods of corrosion control. Calculate and interpret the "C" factor for a section of pipeline.

CONDITIONS: Using the corresponding references and this lesson plan.

STANDARDS: In accordance with the corresponding lesson plan and FM 10-67-1.

REFERENCES: FM 10-67-1 and 7 MIL-HDBK-200G

INTRODUCTION

Until bulk petroleum products are consumed they must be handled many times. The buildup of internal corrosion in a pipeline results in a decrease in throughput, increased maintenance, and contamination of the products moved through the pipeline system.

1. Causes of Internal Corrosion.

a. Water (an electrolyte) is in the fuel and settles out during changes of temperature. This water settles into low points along the pipeline where it contributes to corrosion of the pipe inner surface.

b. Oxygen is present and when combined with water and paraffin (a waxy substance obtained from petroleum) that are present in the fuel, also contributes to corrosion.

c. Mill scale (abrasives) is a surface oxide film. The scale is not a metal but is electrically conductive whose potential is more noble the metal. This means that where breaks in the mill scale occur corrosion will happen. (The metal is the anode, and the mill scale is the cathode.)

d. The combination of the elements (water, oxygen, abrasives, and heat from friction) in the pipeline as the fuel is moved in the pipeline speeds up the corrosion process.

2. Effects of Internal Corrosion.

a. Decreased Throughput. As a buildup of material (wax, mill scale) on the inter of the pipeline occurs there is a decrease in the quantity of products received through the pipeline compared to the past.

b. Increased Maintenance. As a decrease in volume takes place, action to compensate by increasing the discharge pressure may be taken. (If there is an action, there is a counter action). With the increase in pump discharge, there will be an increase maintenance requirement to both the pumps as well as the pipeline.

c. Possible Product Contamination. The presence of water, heat, and solids will effect the product, causing loss of property and possibly microbiologically growth

3. Methods of Preventing Corrosion.

a. Remove Water. Fuel as it is discharged should always be issued through a filter/separator to eliminate water and solids.

b. Remove Oxygen. Fuel can be passed through an air eliminator where pockets of air can be eliminated. To remove oxygen requires the fuel be heated and is not a process employed in the military.

c. Use Inhibitors. The inhibitors form a thin protective film on the pipes, pumps, tanks, and other metal surface with which it comes in contact. There are two types of inhibitors available but only one that is used in military pipeline systems. The inhibitors are water-soluble and oil-soluble.

(1) Water-soluble inhibitor. The water-soluble inhibitor is not used in the military system as it would be removed when the fuel is passed through the filter/separator thereby not eliminating corrosion.

(2) Oil-soluble inhibitors. The oil-soluble inhibitor is used when required. (Reference MIL-HDBK-200G, para 7.3.7.2.) Products such as motor gasoline and diesel fuel have the inhibitor added by the manufacturer; only jet fuel does not have it added. If laboratory test shows a need for an inhibitor, the quantity required can be injected along with the product into the pipeline.

(a) The inhibitor is effective in preventing corrosion on clean metal, will prevent further corrosion on an already corroded metal, and will remove rust and mill scale to a small degree.

(b) The oil-soluble inhibitor can be passed through a filter/separator without removal of the inhibitor.

d. Use Internal Coating (TEFLON). The addition of a coating to the pipe interior is expensive. For the military, it is not a procedure we would use; whereas in some commercial industry (chemical, steam) service, it can be economical. An advantage of this type of material is its corrosive resistance. Only where the material has been damaged is corrosion subject to occur.

e. Use nonmetallic Pipe. Material of plastic, fiberglass, and graphite as well as other materials developed in the future may be used where they can meet the pressure and type of service requirements (hot and arctic cold). These types of material are noncorrosive.

f. Use Scrapers. A scraper will remove buildup on the interior of the pipeline. Corrosion can be controlled but the pipeline over a period of time can have the inside diameter enlarged if the scraper is run too frequently. Additionally, the wall thickness is reduced and external corrosion can weaken the pipeline causing a break.

NOTE: A scraper program should be setup based on need, such as a decrease in throughput and a increase in pressures to maintain maximum flow and reduce product contamination.

4. Measurement of Internal Corrosion.

a. Internal corrosion decreases the capacity of the line by decreasing the effective area of the line. If the velocity of the line is held constant, there will be a decrease in throughput.

b. Several equations have been used to compute a factor to describe the condition of the pipe in service. This is called the C-Factor, and it is computed from an observed head loss between two points in the line under conditions of flow.

(1) We use an equation from "Darcy-Weisbach" to compute head loss due to friction when the friction factor for a new pipe is known. The friction factor derived through the Darcy-Weisbach equation is affected by internal corrosion. The effects of internal corrosion on the relationships expressed by the Darcy-Weisbach equation is to:

(a) Increase the friction factor which results in increased head loss.

(b) Decrease the effective diameter of the pipe which results in increased head loss. Actual reduction in the diameter may be small, but the relative effect is great.

NOTE: For a given flow rate (without considering increased roughness), a 2-percent decrease in diameter increases pressure drop by 10-percent; a 50-percent decrease in diameter increases the pressure drop 27-percent.

(2) The "Hazen Williams" equation is probably the simplest and handiest of several equations which described the relationship among the factors governing the rate of fluid flow through the pipeline.

(a) The C-Factor equation we will use is based on a pressure loss per 1,000 feet of pipe.

(b) The C-Factor is based on an empirical scale which varies from 60 to 160, depending upon the smoothness of the inside wall of the pipe. The smoother the pipe wall, the higher the C-Factor, and the less resistance there is to flow.

(c) A coefficient of 140 is set for new steel pipe, however, this factor may be increased to 150 or 160 through the use of scrapers and inhibitors which have a polishing effect on the inside of the pipe.

(d) A drop in the C-Factor due to build-up of corrosion products in the pipe results in a drop in throughput.

NOTE: An 18-inch line C-Factor drop from 160 to 150, there would be an annual loss in throughput of approximately 4,600,000 barrels.

(3) The results derived from the equation if less then 140 for the C-Factor indicates a POTENTIAL need to schedule a scraper run, or could be for some other reason; such as a partly closed valve or other type of blockage in the pipeline.

NOTE: The “C” Factor Formula is based on Pressure Loss per 1,000 Feet.

(4) The following equation is used to determine the coefficient of corrosion.

$$C = \frac{66\, Q^{0.54}\, G}{D^{2.63}\, p^{0.54}}$$

Where: C = coefficient of corrosion

Q = rate of flow, barrels per hour

D = inside diameter of pipe in inches

P = pressure loss (PSI. per 1,000 feet of pipe length

G = specific (SG) gravity of product

NOTE: In the formula, 66 is a constant, Q and p are raised powers to 0.54, and p is a raised power to 2.63.

NOTE: By using a calculator that has an X><Y “Universal Power Key,” the individual can compute any number raised to a power.

Calculator Example: Inside Pipe Diameter, inches, = d

Pipe diameter: d = 12.481

Raised to (2.63 power) = 764

Use your calculator: Universal Power Key

Pipe diameter; d = 12.481

[Enter] 12.481

[Enter] X><Y

[Enter] 2.63

[Enter] = 764.0748
Answer

NOTE: If decimal place is .5 or greater, round up; if decimal place is under .5, round down

NOTE: The following are changes that would be made to data.

(5) Convert from API to Specific Gravity (SG) or (sg).

Formula to Convert from API to SG.

$$SG = \frac{141.5}{API + 131.5}$$

Given: Observed API = 58 degrees @ 60 degrees F.

$$\frac{141.5}{58 + 131.5} = \frac{141.5}{189.5} = 0.7467$$

(6) Compute the C-Factor:

Given Problem 1: Q = 215 bbl

g(SG) = 0.7428

d = 4.350

p = 3 psi

Using a calculator raise the powers using "X><Y" universal power key, for the previous problem.

C-Factor Calculator Power
Example 1:

Formula:

$$C = \frac{66\, Q^{0.54}\, G^{0.54}}{D^{2.63}\, p^{0.54}}$$

$$\frac{66 * 215 * 0.7428^{0.54}}{4.350^{2.63} * 3^{0.54}} = \frac{66 * 215 * 0.851668969}{47.77786575 * 1.809862066}$$

$$12{,}085.18267 = \underline{139.7593}$$
$$86.47134682$$

NOTE: Answer for this problem: = 140

C-Factor Calculator Power
Example- 2:

Formula:

$$C = \frac{66\,Q^{0.54}\,G}{D^{2.63}\,p^{0.54}}$$

Given Problem 2: Q = 215.71 bbl

g(SG) = 0.7428

d = 4.350

p = (upstream) 285
(downstream) - 282
3 psi

$$\frac{66 * 215.71^{0.54} * 0.7428}{4.350^{2.63} * 3^{0.54}} = \frac{66 * 215.71 * 0.851668969}{47.77786575 * 1.809862066}$$

$$= \frac{12{,}125.09188}{86.47134682} = 140.2209$$

NOTE: Answer for this problem is: = 140

Given Problem 2: The following is a variation of the first problem, by changing the rate of flow from barrels to gallons.

(7) Convert the flow rate from barrels to gallons.

(1) Q = 151 gpm

(2) g(SG) = 0.7428

(3) d = 4.350

(4) p = (285 - 282) = 3 psi

151 gpm * 60 = 9,060 gph/42 = 215.7142857 bbl per hour

NOTE: The answer is 216 bbl per hour.

5. Elevation and Pressure - the following procedures are taken to adjust for elevation differences, the basic equation is for level pipe.

a. Elevation difference between the upstream and downstream points of a pipeline. Pressure readings between the two points of the pipeline are taken from pressure gages and reflect the pressure at what ever the elevation may be.

Example 1:

Upstream elevation - 800 feet,
Downstream elevation - 850 feet.

NOTE: Answer is difference between the two points: 850 - 800 = 50 feet.

Example 2:

Upstream - 225 psi.
Downstream - 195 psi.

NOTE: Answer is difference between the two points: 225 - 195 = 30 psi.

b. To adjust pressure for elevation the following steps are taken.

Formula: The equation for determining pressure loss due to elevation.

$$p_T = p_{EL} + p_{FRIC}$$

Where: EL = Elevation
FRIC = Friction
T = Total
p = pressure

NOTE: To use this formula, it must be rewritten in the following manor:

$$p_{FRIC} = p_T - p_{EL}$$

Examples:

	Upstream	Downstream	
Pressure difference between:	**225 psi**	**and 195 psi**	**= 30 psi.**

Elevation difference between: 800 feet and 850 feet = 50 feet.

c. To determine pressure based on elevation the following equation is used.

Formula:

$$psi = \frac{H * SG}{2.31}$$

Where: H = height (the elevation difference)

SG = specific gravity before rising to the higher power.

2,31 = conversion constant (1 psi = 2.3 1 feet of head of water at 70 degrees F.)

Example:

Height (800 to 850 feet) 50 feet (uphill elevation difference).

Specific Gravity (58 degrees API converts to) 0.7467

$$\frac{50 * 0.7467}{2.31} = \frac{37.335}{2.31} = 16.16233766 \text{ psi}$$

(round to)

16 psi.

NOTE: With the pressure for elevation we can adjust the pressure reading taken from the two gages on the pipeline.

Example: Pressure gage readings; 225 and 195 psi, the difference between the two = 30 psi.

(1) To correct the pressure take the pressure difference from the gages which equals 30 psi and subtract the pressure determined from the elevation which is; 16.

(2) With a gage pressure of 30 psi subtract 16 psi this gives an answer of 14 psi. The figure of 14 is used in the Hazen Williams equation for "p".

30 psi - 16 psi = 14 psi.

NOTE: To further emphasize the elevation and pressure.

Pressure gage reading: 175 psi and 165 psi = 10 psi.

Elevation: 745 and (downstream) 742 = 3 feet

SG.: 0.7467

NOTE:
PROBLEM:
$$\frac{3 * 0.7467}{2.31} = \frac{2.2401}{2.31} = 0.9697 \text{ psi} = 1 \text{ psi}$$

Example: 10 psi - 1 psi = 9 psi used in the formula this has corrected for the gage reading and not for the actual friction and pressure loss.

6. Length of Pipe:

The final factor to affect the results obtainable with the Hazen Williams equation is length. The equation is based on pressure over a length of 1,000 feet. If the distance is greater then 1,000 feet you divide by 1,000 to arrive at a figure used to divide the pressure by.

Example:

Pipe Length; 5,000 feet.

$$\frac{5{,}000}{1{,}000} = 5$$

NOTE: The final step is to calculate the corrected pressure after adjusting for elevation.

Example:

P = (adjusted for elevation) 35 psi

$$\frac{35}{5} = 7 \text{ psi (per 1,000 ft)}$$

LESSON 15

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What is the pipe length for the following data?

Given: 10,000 feet over a length of 1,000 feet.

A. 10
B. 15
C. 50
D. 500

2. Given: The following data, what is the C-Factor?

Q =1,071 gpm

G = 54 degrees API.

d = 8.415 inches

p = (upstream) 184 psi @ 747 feet.
(downstream) 139 psi @ 824 feet.

Length = 4,000 feet.

A. 126
B. 136
C. 146
D. 156

LESSON 15

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. A. 10, (page 15-9, para 6)
2. B. 136, (page 15-3, para 4) See solution below.

Solution for practical exercise 2:

STEP 1; Convert Q.

1,071 gpm * 60 min. = 64,260 gph

64,260 /42 = 1,530 bbls per hour flow rate.

STEP 2; Convert G.

$$\frac{141.5}{54 + 131.5} = \frac{141.5}{185.5} = 0.7628032 = 0.7628$$

STEP 3; Convert p.

Elevation: 747 - 824 = 77 feet

psi: 184 - 139 = 45 psi

STEP 4: Convert elevation to pressure.

$$\frac{77 * 0.7628}{2.31} = \frac{58.74}{2.31} = 25.428571 = 25.43 \text{ psi}$$

STEP 5: Correct for pressure difference (Elevation and Gages).

(Pressure Gage Difference)		(Elevation to psi Conversion)		(Corrected psi)
45	(-)	25.43	(=)	19.57 psi rd (19.6 psi)

STEP 6: Divide length and psi to obtain psi for 1,000 feet.

Length Divide By 4,000

$$\frac{4{,}000 \text{ feet}}{1{,}000} = 4$$

STEP 7: Utilizing information from step #5 and step #6 to obtain the psi per 1,000 feet.

(Step #5, results) (Step #6, results)

19.6 (divided by) 4 = 4.9 psi for 1,000 feet.

Substitution:

$$C = \frac{66\, Q^{0.54}\, G}{D^{2.63}\, p^{0.54}}$$

$$\frac{66 * 1{,}530^{0.54} * 0.7628}{8.415^{2.63} * 4.9} = \frac{66 * 1{,}530 * 0.8640}{271^{0.54} * 2.36} =$$

$$\frac{87{,}246.72}{639.56} = 136.41678 = 136$$

LESSON 16

EXTERNAL CORROSION

Critical Tasks: 01-5103.30-2123
03-5103.00-0078

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn how corrosion in petroleum and water systems can occur and be controlled. You will also learn how to conduct support and sustainment operations and set up a maintenance program for petroleum and water equipment and facilities.

TERMINAL LEARNING OBJECTIVE:

ACTION: Learn the reason corrosion occurs, learn about the four causes of external corrosion, and learn about the four corrosion prevention methods.

CONDITIONS: Given the corresponding references, you will simulate the duties and functions of a commander/staff officer responsible for setting up a petroleum and water equipment maintenance and inspection program.

STANDARDS: Identify and explain the reasons corrosion occurs, its causes, and prevention according to FM 10-67-1.

REFERENCES: FM 10-67-1 and MIL-HDBK-200G.

INTRODUCTION

As a petroleum manager, your duties will require supervising and reviewing maintenance operations and PMCS procedures necessary in maintaining equipment and facilities. Considering the high cost of products and facilities, it is important that you have an understanding of corrosion and preventive measures that can be employed to control corrosion.

1. Corrosion.

a. Corrosion is rust oxidation.

(1) Most metals are not found in nature as pure materials. They are combined with other elements such as oxygen, forming compounds we call ores.

(2) To obtain metals from ores, the compounds are subjected to extreme heat to break the chemical attractions between the elements.

(3) Energy is added through each step in the chain to shape the end product.

NOTE: The Corrosion Cycle; the material is constantly trying to return to its natural state.

The Corrosion Cycle

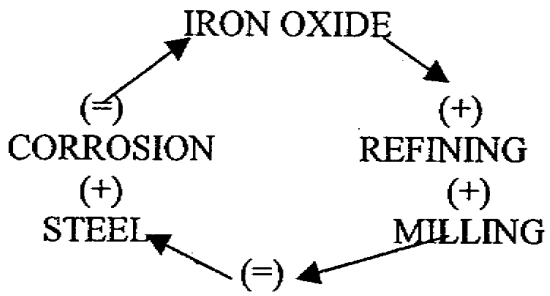

Figure 16-1.

b. Steel corrodes in either soil or water; electrical energy is released as this accrues. Corrosion is a process that has two primary aspects.

(1) A physical change in the metal occurs.

(2) Direct electrical current (D-C) is generated.

(3) This process is referred to as an "ELECTRO-CHEMICAL" reaction.

2. Conditions Necessary For A Corrosion Cell.

- Electrolyte -- soil and/or water.
- Anode -- deteriorates (corrodes).
- Cathode -- protected by the anode.
- External Connection -- Between the anode and cathode (pipe).

NOTE: All four of the above must be present for corrosion to proceed in a corrosion cell.

3. Sources of Corrosion Cells.

Dissimilar Metals:

a. If any two materials shown are placed in a conducting environment, there will be a difference between them.

b. Each metal on the chart has a different potential, this means that a metal "UPPERMOST" on the chart from those lower will make it the "anode."

c. Those metals on the chart "LOWER" than any metal above it on the chart is the "cathode."

NOTE: This means that the material higher up on the chart will be the one to corrode.

4. Galvanic Corrosion.

a. Galvanic corrosion is the self-generated corrosion activity which results when a pipe is placed in the soil. Differences in potential develop song the pipe or between different pips.

b. These differences can result from dissimilar metal as a result of differences within the soil.

c. A simple form of the galvanic cell is the flashlight battery. A dissimilar metal such as aluminum pipe connected to a cast iron valve.

(1) Galvanic corrosion can accrue as there is a difference in electrical potential, this dissimilar metal makes the aluminum pipe anode, and the cast iron valve the cathode.

(2) This means the aluminum pipe will corrode giving up energy in the form of D-C current, to protect the cast iron valve.

d. Where "new" (pipe not used in the past), and "old" (pipe currently in use) pipes are connected (welded), the new pipe will corrode, thereby protecting the old pipe from corrosion. The new pipe will not last as long due to the fact it is corroding to protect the old pipe for whose corrosion is halted.

5. Dissimilar Soils.

Different soils and mineral contents effect the rate of corrosion on a underground structure.

a. The type and consistency of the soils are determined prior to actual construction as well as after construction. A soil survey is conducted to determine the makeup of the soil.

b. The different soils go from "gravel" which gives good drainage, through "silt" which will have a high concentration of corrosive matter (for example, acids, salts and other impurities).

c. The pH is a measure of the acidity or alkalinity of a solution. When the pH is numerically equal to "7" it is a neutral solution. For a pH less than "7," the solution is acidic. For a pH greater than "7," the solution is basic or alkaline. The numerical rating will decrease (down to 0) as the acidity increases (vegetation as it composts). The numerical rating will increase (up to 14) as the alkalinity increases (mineral salt).

d. Resistance in soil to electrical flow will vary due to the type of soils and their makeup (for example, moistness, minerals).

(1) Low soil resistivities result in low circuit resistances. This means higher current flow and more corrosion.

(2) High soil resistivities result in high circuit resistances. This means lower current flow and less corrosion.

(3) Resistance reading are in "ohm-cm," an example of soil resistivity and what the standard is:

Table 16-1 Soil resistivity rating scale

OHM-CM	STANDARD
0 to 1,000 ohm-cm	Very Corrosive
1,000 to 2,000 ohm-cm	Corrosive
2,000 to 10,000 ohm-cm	Mildly Corrosive
10,000 ohm-cm and above	Progressively Less Corrosive

NOTE: The rating scale is only a guide. If for example, general soil resistivities in an area are well above 10,000 ohm-cm, this does not mean that there will be no corrosion... just that the tendency is less.

(4) The preferred resistance is a reading at or above 30,000 ohm-cm, which indicates good drainage, less mineral buildup.

6. Differential Aeration (Oxygen Concentration).

a. This simply means that when "oxygen" from the air (aeration) is more readily available through the electrolyte to one part of a structure than to another, there will be a difference in potential between the two.

b. That part of a structure having restricted oxygen availability will be anodic (anode) and will corrode.

c. Another example of differential aeration is a buried pipeline. The bottom of the pipeline trench is of dense soil, while the relative loose backfill permits greater oxygen availability to the top of the pipe and water drainage (electrolyte) to be present.

(1) In such a situation, DC current can flow from the bottom (anode) of the pipe to the (Cathode) top of the pipe.

(2) This type of corrosion is more difficult to detect as it is not visible on the underside of the pipe.

d. The pipeline passes through a marshy area. The pie to either side of the marshy area is dry and well aerated allowing for higher concentrations of oxygen at the pipe, whereas the part of the pipe in the marshy area has a higher concentration of electrolyte (water/moisture).

7. Stray Current Migration.

a. Stay current corrosion is that caused by direct current traveling through the earth from some source external to the underground metallic structure. It then can be picked up by the structure at one point (creating a "cathodic" condition), flow along the structure (example: pipeline) for a distance, and then discharge into the environment to complete the circuit to the external source.

NOTE: The point of discharge from the metal structure is the anodic (anode) also referred to in the corrosion field as a "holiday."

b. Stay currents tend to be most severe on long underground structures, such as pipelines, but can be a problem with any underground structure if stray currents are present in the earth.

c. Sources of stray current can be either man-made (usually the more serious) or natural.

(1) Man-made sources of stray direct current include but are not limited to:

- D-C electric motor.
- D-C powered transit (trolley) systems.
- D-C powered mining operations.
- D-C welding operations.
- High voltage direct current electric power transmission systems.
- Cathodic protection systems on underground structures "other than the affected structure."

NOTE: Of the sources listed, all are dynamic sources except the last one which is typically static.

(2) A natural source of stray current is what is known as "telluric" or earth current of magnetic origin. These are direct currents, of a variable nature, in the earth's crust which are a result of variations.

(a) Bacteriological corrosion:

1 Bacteria requires organic material as a food supply. This is normally available to at least some degree in the earth.

2 If a major food supply is combined with oxygen restriction, the corrosion action when located against an underground bare metal structure can be intensified. An example is a piece of wood lying against a bare metal pipe, bacteriological corrosion can begin.

(b) Combination Sources of Corrosion Cells.

1 A corrosion problem at a given point on an underground structure is not necessarily confined to just one of the previously discussed types of corrosion cells.

2 Two or more sources of corrosion cell current may be acting at a given location, such as dissimilar metals and differential aeration.

8. Factors Affecting Rate of Corrosion.

NOTE: The following factors that can affect the rate of corrosion once a corrosion cell is established.

a. There has to be a d-c potential (voltage) between the anode and cathode of the corrosion cell in order for corrosion current to flow.

b. The higher the potential, the higher the current flow and the greater the amount of corrosion.

9. Corrosion Controls.

a. Corrosion control procedures can be used and can result in a high degree of freedom from corrosion.

b. The use of preventive corrosion control measures put into effect when an underground metallic structure is built is the best way to go, If this is not done, and corrosion does occur, after-the-fact corrosion control measures can be applied to alleviate further corrosion.

(1) Coatings.

(a) It has been learned that whenever direct current flows from an underground metallic structure into a surrounding electrolyte (earth or water), the metal will be consumed (corroded) at the points of current discharge.

(b) Following simple logic, if an insulating barrier (a coating) were to be placed between the metal and the surrounding electrolyte, corrosion current could not flow and there would be no loss of metal.

(c) Before we decide that coatings are the ultimate answer to corrosion control on underground structures and that we need look no further, must be understood that there is a very important catch to any statement on the use of coatings. A coating if it is to perform as intended, must be “perfect”, and must “remain” perfect.

1 Adhesion -- The coating must be tightly bonded to withstand handling, and backfilling and prevent moisture and corrosion accumulation at the coated steel surface.

2 Electrical Resistance -- The coating must provide electrical insulation (inasmuch as corrosion is electro-chemical) and must be suitable for use with cathodic protection for long term protection.

3 Water Resistance -- The coating must ensure that the material's initial high electrical resistivity does not diminish. Properties of water and electrical resistivity are related in that, as a coating absorbs water, electrical resistivity deteriorates.

4 Chemical Resistance -- The coating must withstand corrosion effects of soil chemicals and must have resistance to oils on pipelines and underground storage tanks.

5 Soil Stress Resistance -- The coating must resist the deformation forces of alternate wetting and drying cycles on the soil.

6 Economical Asset -- The coating must provide long-term protection.

c. On underground structures such as pipelines, it is not economically or practically feasible to apply an insulating coating that will meet these criteria over the full length of the pipeline.

(1) Many types of coatings have been developed over the years. Vinyls and epoxies are often used for submersion service. Coal tar enamel, extruded polyethylene, and epoxies are all used underground.

(2) The best coating material if not applied and handled properly provides a poor overall job.

(a) Properly cleaned surface -- Surface preparation is more than likely the single most important factor in securing a good coating job.

(b) Proper priming -- Not too thick or thin (some coatings do not require a primer).

(c) Proper application of coating -- Temperature, thickness, and cure.

(d) Proper handling of coated surface -- After application, do not mishandle (drop, bang, or scar) coated pipes.

10. Other Protective Methods.

a. Galvanic (or Sacrificial) Anode Cathodic Protection.

(1) Advantages:

(a) Self-powered -- normally do not depend on an outside source of power.

(b) Low maintenance requirements.

(c) Minimum stray current -- probability of interference on other underground structures minimum.

NOTE: The pipe is the "cathode", which is connected to the "anode" placed along side the metal structure. An insulated cable connects the pipe (cathode) to the anode. The anode must be composed of a metal listed higher on the metal activity series list. D-C current flows from the anode through the earth (electrolyte) to the cathode (pipeline) then back to the anode by way of the insulated cable.

NOTE: The galvanic/sacrificial anodes are installed not along the full length of pipeline but only at points where additional corrosion protection is needed due to high corrosion probability. This installation will cause points on the pipeline that are anodic to become cathodic (areas that are already cathodic will remain cathodic), thereby stopping corrosion.

(2) Limitations:

(a) Low driving voltage.

(b) Relatively low current output capacity.

NOTE: The protective current generated by galvanic anodes depends upon the inherent potential between the anodes and the structure to be protected.

1 If the structure is made of iron or steel, any metal which is more active (higher) in the electromotive series can be used as anode material.

2 Materials which are used for galvanic anodes are zinc and magnesium. Magnesium has a much wider use due to its higher voltage. Aluminum is also used, but primarily where seawater is encountered.

3 In underground applications, these anodes are usually surrounded with a special backfill mixture. The backfill is usually a mixture of gypsum, bentonite and sodium sulfate. There are a number of reasons that the backfill serves;

- Uniform environment for the anode thereby uniform corrosion.

- A decrease in the anode-to-earth resistance.
- Retains moisture thereby maintains a lower resistance.

b. Impressed Current Cathodic Protection.

(1) Whereas galvanic mode installations are self-powered, impressed current installations use a separate source of direct (D-C) current. The current from this source is impressed on the circuit between the structure to be protected and the ground bed.

(2) An A-C (alternating current (120, 240, or 440 volts)), is connected to a "rectifier" that changes the power to D-C (direct current). An insulated cable connects the rectifier to the ground bed (anode). Current flows from the ground bed (anode through the earth (electrolyte) to the metal structure, then along it to the cable connection on the metal structure. Finally, the current moves along the cable connection between the metal structure and the rectifier to complete the circuit.

(3) Rectifiers commonly used have a fixed output, that are adjusted to suit a specific requirement. For cases where current output changes are required, there are automatically controlled rectifiers.

(4) Advantages of impressed current installations.

(a) Wide range of D-C voltage and current output capacities. (This provides great flexibility in system design.)

(b) Single installations which will protect much larger structures. (This provides protection to structures that a galvanic anode installation cannot)

(5) Disadvantages of Impressed Current Installations.

(a) Greater maintenance required.

(b) Dependence on availability of a dependable power supply.

(c) Continuing energy cost for A-C current

12. Drainage (Mitigation) Bonds.

This type of corrosion control method is particularly applicable to stray current corrosion problems.

a. Stray current travels along the metal structure until a point of exit is reached; at this point corrosion accrues.

b. The drainage/mitigation bonds are insulated cables attached to the metal structure and provide a path for the stray current to return to its source without damage to the structure.

13. Design.

Before a system is built and during the design stage, the protection system is considered. Soil samples along the route are taken and tested to determine corrosion areas and the type of protection methods needed. All forms of protecting can and will be used to control corrosion on the metal structure.

LESSON 16

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What is one of the reasons that corrosion occurs?

   A. A difference in potential.
   B. It does not occur.
   C. Energy is subtracted through each step in the chain to shape the end product.
   D. There was no oil in it.

2. What are the four causes of external corrosion?

   A. Similar metal, similar soil, Nondifferential aeration, Direct current migration
   B. Dissimilar metal, dissimilar soil, differential aeration, stray current migration
   C. Dissimilar metal, similar soil, differential aeration, stray current migration
   D. Similar metal, dissimilar soil, nondifferential aeration, direct current migration

3. An insulating barrier placed between a metal and a surrounding electrolyte, is known as a?

   A. Coatings
   B. Sealants
   C. Berm
   D. Carrier

LESSON 16

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. A. A difference in potential, (page 16-4, para 6a).

2. B. Dissimilar metal, dissimilar soil, differential aeration, stray current migration, (page 16-2, para 3a., page 16-3, para 5b, page 16-4, para 6 (c)(2), and page 16-5, part 7a).

3. A. Coatings, (page 16-6, para 9 b(1)(b)).

LESSON 17

METERS, METER VERIFICATION, AND PROVER TANK.

Critical Tasks: 01-5103.00-0003
03-5103.00-0024
03-5103.00-0082
03-5103.00-0090

OVERVIEW

LESSON DESCRIPTION:

In this lesson you will learn how to operate positive displacement, turbine, and inferential meters; uses protective devices; and uses a prover can.

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe the operation of positive displacement, turbine, and inferential meters, understand the use of protective devices, and verify a meter based on the volume recorded by a meter and a 5-gallon prover can.

CONDITION: You are a petroleum officer responsible for accuracy of all meters on petroleum equipment IAW FM 10-67-1.

STANDARD: Placed in a role of a petroleum manager and given situational data, the you will identify the various types of meters, calculate a meter correction factor based on the volume recorded by a meter and a prover tank, and calculate the quantity of fuel issued using the meter correction factor.

REFERENCES: FM 10-67-1

INTRODUCTION

Accounting for fuel is one of the most important aspects of operations in the field. If you are using meters for accountability, then you must understand how they work in order to properly protect the meter and ensure that they are properly calibrated.

1. Types of Meters.

Meters are devices used to keep track of the amount of fuel that flows through sections of pipeline and into or out of storage tanks, tank cars, and tank vehicles. The use of meters can cut down on losses during fuel receipts and deliveries.

a. Positive displacement meters. As the name implies, a positive displacement meter measures the flow by separating the flowing stream into volumetric segments and counting them.

(1) Design and construction. There are typically three basic subassemblies in a positive displacement meter.

(a) External housing. This is the pressure vessel with inlet and outlet connections. Meters may be of single or double case construction. The single case acts as a pressure vessel and as the outer wall of the measuring element. Small meters (less than 6 inches) are normally single case. Double case construction is used on meters over 6 inches. The advantage of double case construction is the piping stress or pressure is not transmitted to the measuring element.

(b) Internal measuring element. This measures the volumetric flow by continuously separating a flow stream into discrete volumetric segments and counting them. It is also used to drive the counter.

(c) Counter drive train (counter or totalizer). The gear ratio of the drive train is designed to convert the fixed volume per revolution to the number of gallons or barrels and is transmitted to the counter. The calibrator (adjustor) is used to adjust the counter for slippage through the meter. It may be used if the meter is outside the authorized tolerance.

(2) Operation and maintenance.

(a) Because of the design of the positive displacement meter, it must be protected from dirt and trash. Any solid material passing through the meter will cause it to malfunction.

(b) The meter will also register any air passing through the housing. The clearance between the housing and the vane is usually .004 inches to .005 inches.

(c) Because of their simplicity, positive displacement meters are the most commonly used in petroleum operations and are used as master meters in the place of provers.

b. Turbine meters. Turbine meters are precise measuring devices, even though they are classified as inferred rate meters. They go from simple measuring devices to very complex instruments, and are much smaller than positive displacement meters. There are three basic subassemblies in a conventional turbine meter.

(1) Design and Construction.

(a) Meter housing. The mete housing assembly is constructed of a flanged pipe spool and houses the internal parts.

(b) Internal parts. The heart of the internal parts subassembly is the rotor blade suspended in the flowing stream on the platform bearing and rotor shaft.

(c) Detector Subassembly. In the more complicated meters, you have the viscosity compensator and the magnetic reed switch. In this kind of meter, the flow is corrected to 60°F.

(2) Operation and maintenance.

(a) When the meter is installed, it must have straightening vanes upstream and downstream of the meter. The pipes are usually 5-pipe diameters long downstream, and 10-pipe diameters upstream. This prevents fluid swirl and cavitation due to back pressure, which will cause the meter to lose accuracy (reference API standard 2534). The meter is accurate up to 1/10th of 1 percent and is used for custody transfer. However, the meter requires a lot of maintenance and expertise. They are generally not used by the military.

(b) Turbine meters, like positive displacement meters, will register air and any obstructions from trash which can affect the flow. The meter must be protected while in operation. Protective devices consist of air eliminators and basket-type strainers. These will be discussed later.

c. Inferential rate meters.

(1) The inferential rate meter is an instrument whose primary element (orifice plate) when placed in a flowing stream, infers the flow rate by known physical laws (pressure drop based on the viscosity of the fuels). The orifice plate is machined to exact tolerances.

(2) The secondary element is used to record the quantity of fuel passing through the meter. It consists of piping, high and low pressure sealing pots, and a 24-hour recording chart. The 24-hour chart registers the viscosity of the fuel (based on pressure drop) and the flow rate in BBLS over a 24 hour period.

(3) Operation maintenance.

(a) When the meter is installed, it must have straightening vanes upsteam and downstream. The length of the pipe depends on the size and type of valves used. The meter also requires protection from trash in the flowing stream (line strainers). The meter itself requires a great deal of maintenance and expertise to keep it in proper operating condition.

(b) Orifice meters are used in pipelines where the interface passage needs to be monitored.

2. Protective Devices.

a. Line strainers. Line strainers consist of a metal housing which holds a canister-shaped wire mesh strainer. The mesh is usually 25 mesh or more.

(1) Uses. Line strainers are used in the suction side of pumps and on the inlet side of meters preventing debris from entering the pump and damaging the impeller or meter.

(2) Maintenance. Line strainers should be inspected and cleaned on a periodic basis (recommended once a week). The gaskets are checked for damage, cleaned, and returned to use.

b. Air eliminators.

(1) Description and uses. Air eliminators are placed in the line on the intake side of the meters. It consists of a cylinder usually 14 to 20 inches in diameter containing baffles that are designed to force the flow of fuel to the bottom of the cylinder and air to the top. On the top of the cylinder is a diaphragm float-activated valve. The float holds the valve open allowing air and vapors to escape to the atmosphere. When all air is removed, the float rises in the product and closes the valve.

(2) Maintenance. The flange gaskets should be checked daily for leaks. The diaphragm valve should be checked daily to ensure it is working properly and replaced if needed. Remove any rust and paint.

3. Proving Devices.

Provers are used in any installation where you have to calibrate meters in pipelines, loading docks, and dispensing areas. The maintenance of meters is very limited. Check for dents or distortions and make sure the sight gages are in good working order. Make sure the thermometers are certified.

a. Proving cans. (Field Standard Test Measure) A small meter can be verified by running fuel through the meter into a 5- or 10-gallon graduated can or a proving tank which holds an exact amount of fuel.

b. Mechanical displacement provers. These provers have a calibrated continuous loop and a spheroid. The sphere displaces a known volume from the number one sensor to the number two sensor, and the amount displaced is compared to the meter reading. You will find this kind of meter in fixed installations or they may be trailer-mounted.

c. Open volumetric prover. The open prover can be trailer-mounted or in a fixed installation. They consist of the tank, the neck of the prover, splash dome, overlapping site gage glasses, and the gage glass scale in the neck of the prover. Thermometers are at the top and bottom. The open volume prover was once the field standard prover for Army petroleum facilities. Since IPDS was fielded, this prover is no longer used.

4. Meter Installation.

a. A typical meter installation would be set up as follows:

(Direction of flow) > (items in order) a-b-c-d.

(1) Filter/separator.

(2) Strainer.

(3) Air eliminator.

(4) Meter.

b. The strainer is downstream of the filter/separator in case you have a ruptured element. The strainer will catch any fiberglass or filter paper that might get into the meter and cause it to hang up. There would also be a strainer in the system on the suction side of the pump. This would prevent any trash from entering the filter/separator.

5. Verification Requirements.

a. Meters must be verified based on the following factors:

Table 17-1. Meter Verification Factors

Size of Meters (GPM)	Total Gallons Measured
10-99	200,000
100-299	800,000
300-599	1,200,000
600 and over	2,000,000

Every meter must be verified every 12 months or whenever the meter is suspect, whichever comes first. The meter must be within .0025 (1/4 gallon) for every 100 gallons registered by the master meter. If the meter is out of tolerance by more than .0025, then it must be adjusted, or taken out of service. If this cannot be done, then you may use the mer factor to adjust the meter registered reading on the gallons pumped. The instructions for adjusting the meter are normally placed inside the top cover or in the manufacturer's manual.

b. Considerations

(1) A meter should be proved in its normal installation at the expected operating rates of flow, under the pressure and temperature at which it will operate and on the liquid which it will measure. In situations where it is not practical to prove the meter on the liquid to be metered, the meter should be proved on a liquid having a density (API gravity) and viscosity as close as possible to those of the liquid to be measured. A meter that measures several different liquids should be proved on each such liquid.

(2) The proving of a meter is like a laboratory test; when properly done, it can provide a high degree of repeatability, which is necessary for measurement accuracy. There are as many details of the meter, its piping and the proving system, which can contribute to measurement uncertainty, as there are in determining physical properties of the measured liquid, temperature, corrosion, and trapped air. Thorough inspection of the provers and their appurtenances should be made with sufficient frequency to ensure reproducibility of proving results. It is essential that meter performance data be observed, recorded, and studied, and that calculations be correct.

c. Preparation

(1) The prover must have the capacity for no less than the volume delivered through the meter in one minute. Exceptions are the 5- and 10- gallon prover cans where meters are verified for field accuracy.

(2) Fill the prover and then empty to the zero mark (dry run). This removes air pockets in the line and warms up the meter.

(3) During the dry run, the time and flow rate can be determined.

(4) All gages and thermometers will be checked for accuracy.

(5) All fittings and valves must be checked for leaks.

d. Verification records and reports.

(1) Meter test results.

(2) Meter certification record. The meter certification record in conjunction with the meter test results is your proof that the meter has been properly calibrated.

NOTE: This certification also includes open volumetric prover. If you are not using this type of prover include only necessary information.

1. Date meter was verified.

2. Meter factor.

3. Was meter factor within .0025.

4. Verification adjustment:

Not Required_____ Performed Date_____
Required but Not Performed_____

5. If adjustment is required but not performed, the meter factor should be used to adjust all issues

6. Use of meter verification record.

7. Remarks:

NOTE: Any repairs or adjustments to the meter should be recorded.

Signed by:_____ Calculations verified by:_____

Date:_____ Date:_____

Figure 17-1. Sample meter certification record.

e. Conducting the meter verification.

(1) Return meter reading to zero.

(2) Fill prover can, stopping flow as close to the zero mark in the graduated neck as possible. Fuel cut line must be in the graduated neck.

(3) Look at meter reading. In order for meter to be within tolerance, the mater should read within the nearest tenth of a gallon for the prover can capacity.

(4) If meter is within tolerance, continue to use. If meter is not within tolerance discontinue use and report to organizational maintenance for calibration or repair/replacement.

LESSON 17

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What are the different types of meters?

   A. Positive Displacement Meters, Turbine Meters
   B. Turbine Meters
   C. Inferential Rate Meters, Positive Displacement Meters, Turbine Meters
   D. Inferential Rate Meters, Turbine Meters

2. What are used in the suction side of pumps and on the inlet side of meters to prevent debris from entering the pumps and damaging the impeller or meter?

   A. Air eliminators
   B. Line strainers
   C. Proving devices
   D. Outlet pumps

LESSON 17

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. C. Inferential Rate Meters, Positive Displacement Meters, Turbine Meters (pages 17-1, (a), 17-2, b., and 17-3, c(1)).

2. B. Line strainers (page 17-3, 2a(1)).

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LESSON 18

PETROLEUM HANDLING EQUIPMENT

Critical Tasks: 01-5103.30-2120
01-5103.30-2147
03-5103.00-0082
03-5103.00-0087
03-5103.00-0090
03-5103.00-0096

OVERVIEW

LESSON DESCRIPTION:

In this lesson you will be come learn about petroleum equipment and their capabilities.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify bulk petroleum handling equipment capabilities of each of the military services and how they are employed in a theater of operations.

CONDITION: Using the corresponding lesson plan and references and notes.

STANDARD: IAW FM 10-67-1, FMFM 4-18, AFP 144-3 and the corresponding lesson plan with at least 75 percent accuracy.

REFERENCES: FM 10-67-1, FMFM 4-18 and AFP 144-3

INTRODUCTION

As a petroleum officer in a joint operation, you should know the capabilities of other services for bulk fuel storage, distribution, and handling to make the most effective use of your assets. This block of instruction is intended to give you a very brief overview of the bulk petroleum handling equipment used by the Army, Navy, Air Force, and Marine Corps. Army equipment and employment will be covered in more detail at the proponent school under Annex C.

1. Army Petroleum Handling Equipment. The Army has the responsibility for inland distribution of bulk petroleum for all services in a theater of operations. To do this mission, the Army has developed new systems and improved older ones.

2. Tactical Fuel Systems.

Inland Petroleum Distribution System. - IPDS was designed to meet the Army's requirement to transport bulk petroleum to all land forces in a theater of operations. IPDS consists of three major components:

a. Pipeline. The IPDS pipeline is a 6-inch aluminum pipeline with an inside diameter of 6.249 inches. The pipeline system is designed to move over 960,000 gallons of fuel per day and it is configured in 5-mile pipeline sets. The set includes enough pipes, valves, coupling, and accessories to setup 5 miles of pipeline. There are two types of pipe sections in IPDS:

(1) The 19-foot variable wall thickness pipe has a thickness of 0.404-inches from each end and narrows down to 0.188-inch toward the center. The pipe is used on the main run of the pipeline low pressure areas. Because of its varying thickness, the pipe section cannot be cut. However, the ends can be cut and re-grooved once if damaged.

(2) The 9.5 foot constant wall thickness pipe has a thickness of 0.404-inches from one end to the other. Because of its constant thickness, the pipe can be cut to any length desired to close gaps in the pipeline as a result of construction or damage and mostly installed at high pressure areas.

(3) The pipe sections are connected with a snap-lock coupling. The coupling is hinged on one side and secured with a pin on the other. The gasket can be either a one-piece separate gasket or a two-piece integral gasket. Engineer units are tasked with the design and construction of the pipeline; Quartermaster units operate and maintain the pipeline once it is emplaced.

b. Pumping Stations. The IPDS pump station consists of two 6-inch, 3-stage 800-gallon-per-minute centrifugal pumps with an operational output of 1800 feet of head when pumping liquids with specific gravity of 0.85. The station also has scraper launcher and receiver assemblies, a strainer assembly, and a floodlight set. The pump station is designed to allow one pump to move the fuel in the pipeline while the other pump is kept in reserve or is shut down for maintenance.

c. Tactical Petroleum Terminal. The TPT is the largest bulk fuel system in the Army. The TPT can be established as a base, intermediate or head terminal. The basic storage capacity of a system is 3,780,000 gallons stored in eighteen 5,000 barrel (210,000-gallon) collapsible fabric tanks. The TPT also has three 50K optional tank configuration with two 50K tanks each, giving a total storage capacity of 4.08 million gallons.

(1) The TPT consists of three identical fuel units, each fuel unit has three tanks with six 210,000-gallon tanks to allow each TPT to store up to three different fuels if required.

(2) Each fuel unit consists of three tank farm assemblies that consist of two 5,000 barrel tanks, a 600-GPM hose line pump, and associated fittings and hoses to connect the system together.

(3) The primary mission of the TPT is to store bulk fuel both for operational use and a portion of the theater's fuel reserves.

(4) The 1250 GPM Flood and Transfer Pump. This pump is a general purpose pump that is most often found with the TPT. It is used to transfer fuel within the terminal. The pump is a skid-mounted, six-inch, diesel engine-driven, centrifugal pump.

3. Fuel System Supply Point.

The FSSP is the primary method of tactical petroleum storage in the Army. It is a relatively mobile system that can be found throughout the theater of operations as far forward as the DSA.

a. The basic storage tank with the FSSP is the 10,000-gallon collapsible tank, although the 20,000- and 50,000-gallon tanks can also be used.

b. The system uses two 350-GPM pumps with an operational output of 275 feet of head when fuel is being pumped with a specific gravity of 0.85.

c. Filter/separator. The system has two separators for filtering in-coming and out-going fuel.

d. The FSSP uses 4-inch hoses throughout most of the system. The 3-inch, 2-inch, 1 1/2-inch and 1-inch hoses are also used for issuing fuel.

(1) The FSSP has a receiving manifold that can receive fuel from multiple fuel sources. The system can receive fuel from 5,000-gallon tankers, rail cars or assault hose line

(2) The system can issue fuel to bottom load fuel into fuel tankers; to fill 500-gallon collapsible drums; and for cans/drums and vehicle refueling.

(3) The FSSP can also be configured as a 10-point aircraft refueling system with additional hoses and nozzles required.

4. Forward Area Refueling Equipment.

The FARE system is designed to be a mobile, two-point aircraft refueling system. The system can be set up in as little as 15 minutes by experienced personnel. The FARE system consists of the following major components:

a. Pump -- 100 GPM centrifugal pump driven by a gasoline engine.

b. Filter/separator -- 100 GPM two-stage.

c. The FARE system uses 2-inch collapsible hoses. There are four 50-foot sections of discharge hoses and twelve 5-foot sections of suction hoses.

d. Noncomponents:

(1) Fuel Source -- two 500 gallon collapsible drums. These drums are not components of the FARE system, but they are normally used because of their mobility. Other sources can also be used such as 5,000-gallon tankers, 10,000-gallon or higher capacity collapsible tanks.

(2) A water detector kit adapter used to perform quality surveillance on the fuel and the filter/ separator.

(3) Fire Extinguisher -- three dry-chemical or carbon-dioxide fire extinguishers are a necessity for the safe conduct of aircraft refueling operations.

5. HEMTT Tanker Aviation Refueling System.

The HTAR System is designed as a light-weight, rapidly assembled four-point aircraft hot refueling system to be used with the M970 HEMTT tanker. All connections in the HTAR system are unisex, dry-beak couplings. The couplings are designed to prevent fuel from flowing if the connections are not made properly. The system consists of one 3-inch by 50-feet and ten 2-inch by 50-feet discharge hoses. It also includes four nozzles. It has four CCRs, four D-1s, and four overwing and recirculation nozzles.

6. Petroleum Tank Vehicles.

a. Tank Trucks. They are used for fuel servicing. The fuel handling equipment and the carrier are one piece of equipment or permanently fixed to the carrier chassis, except the tank and pump unit.

(1) Tank and Pump Unit. The TPU is designed to be mounted on a 5-ton cargo truck for retail operations. TPUs can be found in units that have large numbers of vehicles. The TPU consists of the following major pieces of equipment:

(a) Two 600-gallon welded aluminum tanks and a pump A-frame which houses the 50-GPM centrifugal pump electrically driven by the vehicle's 24-volt battery system. The frame also houses a 50-GPM filter/separator and two 40-foot by 1/2 inch dispensing assemblies mounted on hose reels.

(b) A ground reel for grounding the pump and filter/separator assemblies, and a metering kit which has to be ordered separately.

(2) The TPU can only store and issue one type of fuel. A second type of fuel can be carried on a trailer-mounted 600-gallon tank, but the fuel from this tank must be gravity fed or issued through another pump and filter/separator.

b. M978 HEMTT Tanker.

The Heavy Expanded Mobility Tactical Truck (HEMTT) tanker is a 2,500 gallon capacity tank truck found in combat units to provide transportation and distribution of petroleum. The vehicle can operate both on- and off-road and has a highway range of 300 miles. The vehicle weighs 10 tons and has a 445 horsepower diesel engine.

(1) The tank is a 2,500-gallon stainless steel shell with baffles and a man-hole cover. The transporting capacity, both highway and cross-country, is 2,500 gallons.

(2) The pump is rated at 300 GPM powered by the vehicle's engine through the use of a power take-off The M970 also has an auxiliary pump rated at 25 PM that is powered by the vehicle's 24-volt electrical system.

(3) The filter/separator is a vertical type rated at 300 GPM with two stages of filtering.

c. Tanker Semitrailers - The Bulk transport tankers and fuel servicing tankers are the two types. The difference between the two is that, the transport tankers are not equipped with filtration equipment; therefor, the cannot refuel an customers. The fuel servicing tankers can transport and also service other vehicles or customers. Both types require a prime-mover, normally a 5-ton tractor.

(1) Bulk Transport Tankers.

(a) The M967 is a 5,000-gallon bulk fuel transporter designed for both on-the-road and limited off-road use. The tank is a stainless steel, single compartment shell with baffles. It has a highway carrying capacity of 5,000 gallons and 3,800 gallons cross-country.

(b) The pump is a 4-inch, low-pressure, high volume, 300 GPM centrifugal pump driven by a diesel engine. It has a bulk delivery rate of 600 GPM and a self-load rate using its onboard pump of 300 GPM.

(c) The manifold system of the tanker is 4-inch diameter, and has one dispensing assembly made up of three 4-inch by 14-feet suction hoses for bulk delivery and self-loading operations.

(2) M1062. The M1062 is a 7,500-gallon bulk fuel transporter designed specifically for highway or improved roadway use only. The tank is a stainless steel, single compartment shell with baffles. The M1062 has no pump or filter/separator. It has one dispensing assembly which is made up of three 4-inch by 15-foot suction hoses for gravity delivery.

d. Fuel Servicing Semi-Trailers.

(1) The M969 is a 5,000-gallon tanker designed to refuel ground vehicles and/or aircraft. The tank is a stainless steel, single compartment shell with baffles. It has a highway carrying capacity of 5,000 gallons and 3,800 gallons cross-country.

(a) The pump is a 4-inch, low-pressure, high volume, 300 GPM centrifugal pump driven by a diesel engine. It ha a bulk delivery rate of 600 GPM and a self-load rate using its onboard pump of 300 GPM.

(b) The manifold system of the tanker is 4-inch diameter and has three dispensing assemblies. Two are mounted on hose reels and one made up of three 4-inch by 14-feet suction hoses for bulk delivery and self-loading operations.

(c) The filter/separator is a horizontal type, rated at 300 GPM with three stages of filtering.

(2) The M970 is a 5,000-gallon tanker specifically designed for over-wing and under-wing refueling of aircraft. The tank is a stainless steel, single compartment shell with baffles. It has a highway carrying capacity of 5,000 gallons and 3,800 gallons cross-country.

(a) The pump is a 3-inch, high-pressure, low volume, 300 GPM centrifugal pump driven by a diesel engine. It has a bulk delivery rate of 600 GPM (bypassing filter/separator), 300 GPM delivery through the filter/separator and a self-load rate of 300 GPM, using its onboard pump.

(b) The manifold system of the tanker is 4-inch diameter and has three dispensing assemblies. Two are mounted on hose reels and one made up of three 4-inch by 14-feet suction hoses for bulk delivery and self-loading operations.

(c) The filter/separator is a horizontal type, rated at 300 GPM with three stages of filtering.

7. Aircraft Delivery System. The CH-47 ERFS, better known as Fat Cow, is a modular, interconnected system composed of up to four 600-gallon noncrashworthy tanks; four electrically driven fuel pumps used to feed the aircraft's main fuel tanks; a vent system; and associated wiring, plumbing and mounting hardware. The system can provide up to 2,320 gallons of fuel and is used to extend the CH-47's operating range. The ERFS system can also be used as a fuel source at forward sites. When the system is used this way, additional equipment is needed, such as pumps, filter/separators, hoses, and fittings to establish the required amount of aircraft refuel points.

8. Marine Corps Petroleum Handling Equipment. The Marine Corps uses several tactical fuel systems that are similar to Army systems. The Marine Corps is organized to support both air and ground petroleum requirements and can be the responsible service for inland petroleum distribution in the absence of the Army.

9. Tactical Fuel Systems.

a. Amphibious Assault Fuel System. The AAFS is the largest of the Marine Corps' tactical fuel systems. It is designed to receive, store and issue bulk to all elements of a MAGTF including distribution by hose line to airfields.

(1) The AAFS can receive fuel from ship-to-shore operations from naval, MSC, or commercial shipping. In addition, the AAFS is capable of receiving fuel from naval landing crafts, barges, railroad tank cars, tank trucks, pipelines, hose lines, and fixed facility bulk tanks and drums to include transferring fuel by hose line to other storage areas. It can store more than 600,000 gallons in its 5-tank farms, 80,000 gallons in the two-booster stations, and 40,000 in the beach unloading assembly, giving the maximum capacity of 720,000 gallons of a single type of fuel.

(2) The system consists of several self-contained units or assemblies:

(a) One beach unloading assembly -- consists of two 600-GPM pumps and two 20,000-gallon collapsible drums. The assembly is used for receiving fuel during ship-to-shore operations.

(b) One drum unloading assembly -- consists of a 600 GPM pump with four drum unloading points.

(c) Two booster station assemblies -- consists of a 600 GPM hose line pump and two 20,000-gallon collapsible drums. The booster station assemblies are used when the distance between storage sites is greater than the capable pumping distance.

(d) Two adapting assemblies -- to make the system compatible with commercial and other services' fuel systems.

(e) One dispensing assembly -- provides tile capability to dispense fuel.

(f) Five-Tank Farm assemblies -- each assembly consists of six 20,000 gallon collapsible tanks and a 600 GPM pump.

(3) The AAFS consists of approximately 3.5 miles of 6-inch collapsible hose and uses ten 600 GPM pumps. It can store up to 600,000 gallons of bulk fuel in the five tank farm assemblies.

b. Tactical Airfield Fuel Dispensing System. The TAFDS resembles the AAFS but on a smaller scale. Whereas the AAFS supports the overall requirements of the MAGTF, both air and ground, the TAFDS supports a specific tactical airfield requirement. It is designed primarily to provide aircraft refueling a expeditionary airfields. With the single fuel on the battlefield concept, the TAFDS will also be able to issue fuel for ground vehicles. The system can be employed as a whole, in part, or in conjunction with another TAFDS. It is easily assembled and is air transportable. The TAFDS consists of:

- Six 20,000 gallon collapsible tanks (120,000-gallon capacity).
- Three 350-or 600-GPM pumps.
- Six 350-GPM filter/separators.
- Six 350-GPM fuel monitors, each monitor contains 20 GO-NO-GO fuses
- Three 2-inch and 3-inch meter assemblies.

c. Helicopter Expeditionary Refueling System. The HERS is designed for support of helicopter operations in advanced areas and remote sites, normally at FARPS. The HERS is very similar in design and capability as the Army's FARE system. The major difference between the

two systems is that the HERS uses either two 100-or 125-GPM pumps, two fuel quality monitors, each containing 10 GO-NO-GO fuses. The HERS has four 2-inch meters assemblies and can establish a four-point refueling system. The HERS consist of

- Eighteen 500 gallons collapsible drams (9,000-gallon capacity).
- Two 100- or 125-GPM pumps
- Two filter/separators and fuel quality monitors.
- Four meter assemblies and an assembly of hoses and fittings to connect the system.

(2) The HERS is employed the same way as the FARE system. The MWSS F/W fuel branch has two HERS, while the MWSS R/W has seven. The HERS is used to establish FARPS at advanced areas to extend the range of USMC attack and utility helicopters.

d. Expeditionary Refueling System. The ERS is designed to provide simple, versatile refueling support for ground vehicles. It consists of a 500-gallon collapsible drum and a 100- or 125-GPM pump with hoses and fittings. The ERS system is easily transportable both by ground or air transport and would be employed in advanced positions to refuel ground vehicles.

e. Six Container System. The SIXCON is normally used by general support CSS elements in a MAGTF to provide storage, transport, and issue of bulk fuel. The SIXCON is both ground and air transportable. The SIXCON consists of a fuel pump module and five fuel tank modules and accessories.

(1) The fuel pump module consists of a 125-GPM pump, a 100-GPM filter/separator, fuel monitor, meter assembly, and a hose reel. The maximum fuel flow in the system is 100 GPM.

(2) The fuel tank modules are made of stainless steel and each tank can hold 900 gallons of fuel. The five modules can fit in a standard ISO container for easy transportation. Each fuel module assembly contains the necessary hoses and fittings to connect to a fuel pump module.

(3) The accessories used with the SIXCON system connects each of the fuel tanks in the modules using two-inch dry-break couplings to allow rapid, easy, and safe assembly and disassembly.

f. Petroleum Tank Vehicle. The Marine Corps' primary petroleum tank vehicle is the M970, 5,000-gallon tanker, the same vehicle previously discussed in Army equipment. This is the only semitrailer the Marine Corps has.

g. Aircraft Bulk Fuel Handling Systems. The Tactical Bulk Fuel Delivery System consists of two kits. The TBFDS - CH-53 and the auxiliary fuel kit.

(1) Tactical Bulk Fuel Delivery Subsystem (CH-53). This is very similar to the ABFDS of the Air Force. However, instead of putting the system in a fixed wing aircraft, the Marine Corps uses this system with the CH-53 helicopter. It is primarily employed to provide bulk fuel at remote locations for both ground and aviation. The system has a carrying capacity from 2,000 to 2,500 gallons of fuel.

(2) Auxiliary Fuel Kit. The AFK will take advantage of the CH-53's capability to range extend itself using sponson tanks, and dispense carried fuel at forward sites. The AFK consists of two 650-gallon (1,300 total capacity) external tanks.

(3) Tactical Bulk Fuel Delivery System (C-130R). The KC-130R tanker can provide aerial refueling for fixed wing and rotary wing aircraft equipped with a refueling boom. The tanker can also air-land to refuel tactical vehicles and resupply bulk fuel storage systems. The KC-130R tanker can hold a minimum of 4,000 gallons and up to 9,000 gallons of jet fuel in its tanks. It uses a drogue and probe assembly for aerial refueling. The drogue and probe assemble will be further discussed in the Navy equipment block.

10. Navy Petroleum Handling Equipment.

The Navy and the Military Sealift Command (MSC) are the primary means of transporting bulk fuel to any theater of operations for use by other services. In addition, the Navy must be able support its own operations both afloat and ashore.

11. DESC Bulk Supply.

a. As sated above, MSC is the primary means of transporting bulk petroleum to a theater of operations. MSC operates 13 fleet oilers around the world to augment the capabilities of the active Navy. Six oilers support the Atlantic fleet, six support the Pacific fleet, and one is a prepositioned ship. The top speed of these oilers is 20 knots; with a range of 6,000 miles at 18 knots. Nine of these tankers have a fuel capacity of 180,000 BBLS (7.56 million gallons), while four have a capacity of 159,500 BBLS. The reduced capacity is a result of the Environmental Act of 1990 requiring double hulls on oil transporting tankers. The following tankers are the most commonly used:

(1) Sealift Class Tanker.

(a) There are nine Sealift class tankers. Each has a cargo capacity of 225,000 BBLS in seven tanks.

(b) The tanker has a draft of 34 feet, 6 inches when fully loaded.

(c) It is equipped with four cargo pumps to offload cargo and has a discharge capacity of 24,000 BBLS/hour using all pumps. The discharge pressure of the tanker is 100 PSI maximum and 50 psi minimum for planning purposes.

(d) The pipe connections on the Sealift class tankers are 12 and 14 inches.

(e) The Sealift class tankers can travel at 16 knots with a range of 7,500 miles and have a crew of 32.

(2) T-5 Class Tanker.

(a) The T-5 class tankers are the most modern in the MSC fleet with the last tanker being delivered in 1986. There are five T-5 class tankers, each with a cargo capacity of 238,400 BBLS in nine tanks.

(b) The tanker has a draft of 34 feet when fully loaded.

(c) It is equipped with four cargo pumps to offload cargo and has a discharge capacity of 24,800 bbls/hour using all pumps. The discharge pressure of the tanker is 125 PSI for planning purposes.

(d) The pipe connections on the T-5 class tankers are 12 to 14 inches.

(e) The T-5 class tankers have a speed of 16 knots and a range of 12,000 miles and have a crew of 23 with 9 officers.

(3) Offshore Petroleum Discharge System.

(a) OPDS was designed to be the answer to petroleum distribution in an undeveloped theater of operations.

(b) OPDS consists of a 15 million gallon tanker, a SALM Buoy, and 4 miles of collapsible hose line.

(c) There are currently 5 OPDS tankers in the inventory. Each tanker can offload bulk petroleum at a rate of up to 1,000 GPM or 1.2 million gallons per day (20 hour operating day).

(d) The SALM buoy is established and allows the tanker to anchor and hook up the hose connections.

(e) Navy construction battalion and underwater diver support ate needed to establish the system.

(f) Once in place, the tanker can discharge petroleum from the SALM buoy to the "high water" mark on the beach, where the fuel is transferred to the Army's IPDS or to Marine Corps' systems. Subsequent tankers can anchor at the SALM buoy and offload their cargoes.

(g) There are five tankers presently equipped with OPDS. They are:

- Potomac -- 168,000 BBLS

- American Osprey - 235,000 BBLS
- Chesapeake -- 255,000 BBLS
- Petersburg -- 255,000 BBLS
- Mount Washington -- 269,000 BBLS

(4) Fleet Support Equipment - The Navy uses fleet oilers and fast combat support ships to provide a sea replenishment of vessels for both bunkering and aviation fuel. There are five fleet oilers (AO) and eight fast combat support ships (AOE) in the active Navy. MSC operates 13 fleet oilers.

(a) Auxiliary Oilers.

1 The AOs are designed to provide two complete refuelings of an aircraft carrier and its escorting destroyers.

2 The fuel capacity for the Active Navy fleet oilers was designed at 120,000 BBLS (5.04 million gallons of fuel). From 1987 to 1990, these oilers were "Jumboised" to hold 180,000 bbls (7.56 million gallons). The top speed of these fleet oilers is 20 knots.

3 The following is a list of the active Navy fleet oilers and the fleets that they support:

- Cimarron --Pacific
- Monongahela -- Atlantic
- Merrimack -- Atlantic
- Willamette- Pacific
- Platte--Atlantic

4 MSC operates 13 fleet oilers around the world to augment the capabilities of the active Navy. Six oilers support the Atlantic fleet, 6 support the Pacific fleet, and one is a prepositioned ship.

5 The top speed of these oilers is 20 knots with a range of 6,000 miles a 18 knots. Nine of these tankers have a fuel capacity of 180,000 BBLS (7.56 million gallons), while four have a capacity of 159,500 BBLS. The reduced capacity is a result of the Environmental Act of 1990 requiring double hulls on oil transporting tankers.

(b) Fast Combat Support Ships (AOE). The Navy currently operates eight AOEs to resupply the fleet with petroleum, ammunition, refrigerated stores and dry stores. There are two classes of AOEs: the Sacramento Class and the Supply Class.

1 Sacramento Class

a The Sacramento Class AOEs have a fuel capacity of 190,000 barrels (7.98 million gallons), 2,150 tons of ammunition, 500 tons of dry stores, and 250 tons of refrigerated stores.

b The speed of these AOEs is 26 knots and has a complement of 600.

c The four Sacramento Class AOEs are:

- Sacramento -- Pacific Fleet
- Camden -- Pacific Fleet
- Seattle - Atlantic Fleet
- Detroit -- Atlantic Fleet

2 Supply Class

a These ships have a capacity of 177,000 BBLS (7.4 million gallons) of POL, 2,150 tons of ammunition, and 500 tons of dry cargo, 250 tons of refrigerated cargo.

b The top speed of these ships is over 25 knots.

c The two Supply Class AOEs and the fleets that they support are as follows:

- Supply - Atlantic
- Arctic-Atlantic
- Rainer- Pacific
- Bridge - Pacific

3 Tanker Aircraft.

a The United States military began developing the concept of in-flight refueling shortly after World War II.

b Since the fuel capacity of the aircraft determines its range and flight time, the concept of in-flight refueling was a must for modern aircraft.

c Aerial tankers were needed to refuel the B-52 bombers that would fly "doomsday" missions.

d The first aerial tankers were based on the Boeing B-29, a four-engine propeller driven bomber. Unfortunately, the B-29 could not keep pace with the modem-day jets it was supposed to refuel. Two Methods of refueling were developed for use in aerial tankers:

- Probe and Drogue Method uses an extendible hose line and basket to refuel aircraft. The aerial tanker extends the basket behind and the refueling aircraft must maneuver to insert the refueling probe into the basket. This method is preferred by the U.S. Navy and a number of NATO countries.

- Rigid Boom Method uses a boom equipped with fins to maneuver the boom. The aerial tanker lowers the boom, the refueling aircraft positions itself behind and below the tanker, and the boom operator maneuvers the boom to insert it into the aircraft's refueling receptacle. This is the method preferred by the U.S. Air Force.

e S-3 Aircraft. This aircraft is a carrier-based anti-submarine attack plane. It has a range of 400 miles and can stay on station for up to 4 hours at a time. The S-3 uses five 400-gallon drop tanks to store fuel and has a probe and drogue assembly to refuel aircraft.

4 Expeditionary Logistics Support Force Equipment. The ELSF equipment will be used by the ELSF to establish land-based refueling capabilities for the Navy in undeveloped theaters. Support will be for both ground equipment and rotary and fixed wing aircraft. With the exception of the first trailer described under the High-Speed Aircraft Refueling System, none of this equipment has yet been procured for these units.

a High-Speed Aircraft Refueling System. This consists of a two-trailer system. The first trailer contains a 300-gallon per minute pump; a 300-gallon per minute filter/separator; a fuel relaxation chamber; and hose reel system. The second trailer (not yet designed or procured) will contain four 10,000-gallon collapsible tanks (empty); extra hoses; and a fuel testing kit. This system is designed to refuel aircraft only.

b Bulk Fuel Storage System. This is a single-product storage and issue system, revolving around four 50,000-gallon collapsible tanks.

c Fuel Service Station. This consists of a single 10,000-gallon collapsible tank plus pump and filter/separator. Its mission is to provide fuel support for Ground Support Equipment (for example, forklift trucks, bulldozers).

d Aviation Fuel Servicing Truck. This is a 5,000-gallon truck designed to provide alongside aircraft refueling, similar to commercial airport refueling trucks.

e Ground Support Equipment/Motor Pool Servicing Truck. This is a 1,200-gallon tanker truck designed to provide mobile fuel support to both ground support equipment and motor pool vehicles.

12. Air Force Petroleum Handling Equipment.

a. Air Force Petroleum Handling Equipment. The Air Force typically uses the largest volume of bulk petroleum in a theater of operations. The majority of Air Force equipment is used for fueling and defueling aircraft and most storage tanks at Air Force facilities are fixed, above-ground tanks. However, the Air Force does have equipment that can be transported for contingency operations to receive, store and issue bulk petroleum.

b. Hydrant Dispensing Systems. Provide a quick and efficient means of delivering large volumes of fuel to aircraft. Systems all have the same basic components: pump house with pumps and filter/separators; pipeline connecting the tanks to the pump house and the pump house to the aircraft refueling area and control pits and hydrant outlets. Hydrant hose carts or trucks connect the hydrant system to the aircraft.

(1) Panero System (Type I).

(a) First hydrant system developed for the Air Force in 1949.

(b) Each system generally has four to six 25,000- or 50,000-gallon storage tanks and one or more 10,000- or 25,000-gallon defuel tanks.

(c) The system can dispense fuel at 300 GPM for fighters and 600 GPM for bombers and other heavy aircraft.

(d) Panero system does not have defuel pumps, so defueling operations must be conducted by gravity flow with assistance from the aircraft's defuel pump.

(e) The control pit has a remote control cable to start, stop, and provide emergency shutdown of fuel flow.

(f) The limiting factor of the Panero system is that it has a small number of hydrant outlets because it uses only one lateral pipe connecting hydrants to the system.

(2) Pritchard System (Type II).

(a) Developed in 1955, this system was a marked improvement over the Panero System.

(b) System has six to eight 50,000-gallon tanks and three to four lateral connections.

(c) The system can refuel aircraft at 600 GPM and defuel at 200 GPM.

(d) The Pritchard System uses a horseshoe magnet attached to a lanyard for emergency shut-off

(3) Constant Pressure Refueling System (Type III).

(a) The Type I hydrant system can refuel aircraft at rates between 1200 to 6000 GPM using a hydrant hose truck rather than a hose cart.

(b) The constant pressure is maintained by a series of continuously running pressure pumps.

(c) The system detects a drop in pressure when a hydrant hose truck connects to a hydrant and brings the pressure up until the rated flow is reached.

(4) Hot Refueling System (Type IV).

(a) This system is used specifically for refueling aircraft with engines running or in a shelter.

(b) The system is similar in all respects to the Type I system except that it uses a pantograph to connect to the aircraft rather than a hydrant hose truck.

c. Fuel-Servicing Equipment.

(1) R-9 tank truck.

(a) The R-9 is a 5,000-gallon fuel-servicing vehicle used for refueling and defueling aircraft.

(b) The vehicle has two hose reds, two 300-GPM meters and a 600-GPM filter/separator.

(c) The hose reels are both 60 feet long. One hose reel has a 3-inch hose with a single point refueling nozzle attached. The other hose reel has a 2-inch hose with an overwing nozzle attached.

(d) The centrifugal pump is rated at 600 GPM and is powered by the R-9's engine through the use of a PTO. The R-9 can refuel from both nozzles simultaneously at 300 GPM or through the 3-inch hose and both meters at 600-GPM. The R-9 can defuel an aircraft at a rate of 200 GPM.

(e) The R-9 can be bottom loaded to fill the tank. The tank is a single piece of aluminum sheet with 15 baffles.

(f) The R-9 control panel has three gages to monitor pressures: a pressure differential gage to monitor the filter/separator; a nozzle pressure gage; and a pump discharge pressure gage.

(2) R-11 tank truck.

(a) The R-11 is essentially the same design as the R-9. The major difference between the two is that the R-11 has a 6,000-gallon tank. The R-11 is replacing the R-9 throughout the Air Force.

(b) The R-11 also uses only one 60-foot hose reel with either 2 1/2- or 3-inch hose and a single point refueling nozzle or overwing nozzle.

(3) C-300 Tank Truck

(a) The C-300 tank truck is a 1,200-gallon ground fuel-servicing vehicle.

(b) The C-300 uses a PTO-driven centrifugal pump rated at 120 GPM. The C-300 does not have a filter/separator.

(c) The C-300 has a 60 foot hose reel with 1 1/2-inch hose and an overwing nozzle.

(4) MH-2 hose cart.

(a) The hose cart is used to filter and meter fuel issued from a hydrant system into an aircraft. The hose cart is normally towed behind a pickup truck or tractor to the area where the aircraft is being serviced.

(b) The MH-2 hose cart consists of a meter; line strainer; filter/separator; two surge suppressers; two static discharge ground reels; and two 4-inch collapsible hose assemblies.

(c) The strainer serves to protect the filter/separator from large solids.

(d) The surge suppressers protect the system from sudden jumps in pressure.

(e) One of the hose assemblies is 30 feet long and connects the hydrant system to the hose cart. The other hose assembly is normally 45 to 60 feet long and has a SPR nozzle attached to refuel or defuel aircraft. Defuel operations are rated at 200 GPM.

(f) The hose cart can be used with either the Panero or Pritchard Hydrant Systems.

(5) Hydrant hose truck.

(a) The HHT is a self-propelled vehicle that contains all of the equipment needed to refuel and defuel aircraft from a constant pressure hydrant system (Type III).

(b) The HHT has the same basic equipment as the hose cart and in addition, it has a PTO-driven defueling pump rated at 300 GPM.

(c) The HHT also has two 50-foot hose reels with 3-inch hoses to connect to the hydrant system and two 50-foot hose reels with 3-inch hose and SPR nozzles to refuel/defuel

aircraft. The HHT can refuel aircraft at rates of 1200-GPM through both hydrant and servicing hoses or 600 GPM through any one set.

(6) HSV-12 Hydrant Servicing Vehicle.

(a) The HSV is also self-propelled and has many of the same features as the HHT.

(b) The HSV was primarily designed to refuel wide-bodied aircraft such as the KC-10 and B-1B. It has a highlift capability to facilitate underwing refueling operations.

(c) The HSV connects to the hydrant system using a 35-foot long 4-inch hose. It services aircraft through two 60-foot long 3-inch hoses with SPR nozzles. There is also an 8-inch lift platform hose to connect the lift platform to the system.

(d) The HSV can refuel aircraft through any one hose at a rate of 1200 GPM and defuel at 300 GPM.

(e) The hydrant servicing vehicle can be used with Type I, II, and III hydrant system, but can only conduct cold refueling or defueling operations and cannot be used in concurrent servicing operations.

(7) GRU-17 Pantograph (Aircraft Field Servicing Unit).

(a) The pantograph can be used with any fuel servicing system that conducts hot refueling.

(b) The pantograph contains the basic valves, pressure regulating gages, and grounding reels needed for refueling operations.

(c) The basic pantograph deign is made of four sections of aluminum pipe connected with sealed swivel joints. The joints allow the pantograph to be positioned to refuel the aircraft. The end of the pantograph has a hose section with an SPR nozzle.

(d) Fuel flow is regulated using a hand actuated valve or "deadman switch."

d. Fuels Mobility Equipment.

(1) R-14 Air Transportable Hydrant Refueling System.

(a) This is the most common type of portable hydrant system used in the Air Force.

(b) It is air-transportable and can be set up in a matter of hours.

(c) The complete system consists of three identical and self-sufficient modules.

(d) Each module consists of a 600 GPM pumping unit and filter/separator, two 50,000 gallon collapsible storage tanks and associated hoses, valves, and fittings.

(e) Each module has a hoist that is used to deploy and redeploy the 50,000-gallon tanks.

(f) The R-14 refuels aircraft using either 2 1/2 inch SPR or 2 inch open port nozzles.

(g) The system can receive an issue fuel through four inch KAM-LOCK couplings. This makes the system compatible with 5,000 gallon tankers used by the Army and Marine Corps.

(h) The R-14 is designed to refuel one heavy aircraft at 600 GPM or two fighter aircraft at 300 GPM.

(2) R-25 ATHRS.

(a) The R-25 is similar to the R-14 in all respects except that it only consists of one module and uses two 10,000-gallon tanks.

(b) The system is designed to refuel small aircraft at rates of up to 300 GPM.

(3) R-26 ATHRS.

(a) The R-26 is a general-purpose refueling system designed to operate from one 10,000-gallon tank, two 500-gallon drums, or four 55-gallon drums.

(b) The system is designed to refuel small aircraft and helicopters or provide ground fuel support. The system is rated at 100 GPM.

(4) R-22 Trailer-Mounted Transfer Pump.

(a) The R-22 is a cart mounted centrifugal pump rated at 900 GPM.

(b) If used with an MH-2 series hose cart or skid-mounted filter/separator, the R-22 can be used instead of the R-14 to issue fuel to aircraft.

(5) Aerial Bulk Fuel Delivery System.

(a) The ABFDS is used by the Air Force to provide bulk fuel delivery capability to forward and remote locations.

(b) One system consists of two 3,000-gallon bladder tanks, a tank armor system, two 600-GPM pumps that can be operated separately or together, and hoses and fittings.

(c) The number of tanks that can be loaded on an aircraft differ with the type of aircraft used.

- C-130 2 tanks; 6,000 gallons
- C-141 3 tanks, 9,000 gallons
- C-5- 8 to 10 tanks, 24,000 to 30,000 gallons

(d) The system comes with numerous adapters and fittings to off-load fuel. When concerned with interoperability, bot services must ensure that the correct fittings are available.

e. Tanker Aircraft. Air Force tanker aircraft operate under the same principles as described under Navy tanker aircraft.

(1) KC-135 Stratotanker.

(a) The KC-135 is a modified Boeing 707 airliner that has been in service in the Air Force since June 1957.

(b) In June 1977, the KC-135 fleet was upgraded to last another 25 years.

(c) The KC-135 has a fuel capacity of 120,000 pounds (17,500 gallons JP-8) and has a range of 1,150 miles.

(d) The KC-135 normally uses a rigid boom assembly to issue fuel to aircraft.

(2) KC-10 Extender.

(a) The KC-10 will eventually replace the KC-135.

(b) Based on the McDonnell-Douglas DC-10, the KC-10 has a range of 3,800 miles. The KC-l0 has a payload capacity of 170,000 pounds (25,000 gallons JP-8)

(c) The KC-10 also normally uses a rigid boom assembly to issue fuel to aircraft.

(d) Both the KC-135 and the KC-10 can be equipped with probe and drogue equipment to refuel Navy aircraft.

(e) The Air Force has also experimented with multiple connections for both rigid boom and probe and drogue assemblies.

LESSON 18

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. Which Marine Corps tactical fuel system is similar in design to the Army's FARE system?

   A. Helicopter Expeditionary Refueling System
   B. Amphibious Assault Fuel System
   C. HEMTT Tanker Aviation Refueling System
   D. Assault Hose line

2. How many gallons and how many products can be stored in the Amphibious Assault Fuel System?

   A. Less than 25,000 gallons of a single fuel.
   B. Up to 600,000 gallons of a single fuel.
   C. 750,000 gallons of a single fuel.
   D. Up to 600,000 gallons of multiple products.

3. What are the two most common types of tankers used by MSC?

   A. None.
   B. The FARE and the T-5
   C. T-5 Class and Sealift Class
   D. T66 and Offshore terminal

4. What Navy aircraft is used for in-flight refueling?

   A. S-5
   B. T-66
   C. SS-3
   D. S-3

LESSON 18

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	A. The Helicopter Expeditionary Refueling System (HERS), (page 18-7, c.).
2.	B. Up to 600,000 gallons of a single fuel, (page 18-7, 9a(3)).
3.	C. T-5 Class and Sealift Class, (page 18-10, (2)(a)).
4.	D. S-3, (page 18-13, e.).

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LESSON 19

ORIGINS AND EXPLORATION OF PETROLEUM

Critical Task: 03-5103.00-0088

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn how to deal with refined petroleum products. You will also be introduced to the exploration and production phases of the oil industry.

TERMINAL LEARNING OBJECTIVE:

ACTION: Learn about the elements that are essential for the formation of a petroleum deposit learn about the two methods for stimulating reservoir rock; and learn about the primary and enhanced recovery methods.

CONDITIONS: IAW NAVEDTRA 10883-B, ISBN 0-87201-577-7, ISBN 07-001600-3 and the corresponding lesson plan.

STANDARDS: With at least 70 percent accuracy.

REFERENCES: NAVEDTRA 10883-B, ISBN 0-87201-577-7, and ISBN 07-001600-3

INTRODUCTION

As a petroleum officer, you will be dealing with refined petroleum products such as jet fuel, gasoline, diesel fuel, burner oil, and lubricating oil. You will have little reason to concern yourself with the problems involved in finding, producing, and refining crude oil into the numerous products you will be managing; however, it is important for you to realize that the petroleum product is the end result of a long, involved process. For this reason, it is appropriate that you examine the exploration and production phases of the oil industry.

1. Formation of Petroleum Reservoirs.

a. Sub-Surface Occurrences. In order for a petroleum reservoir to form, there must be three distinct sub-surface occurrences. You must have:

(1) A source bed (the bed in which petroleum originally formed).

(2) A porous and permeable carrier and reservoir rock (rocks suitable for holding the fluid and allowing the fluid to move, this will be discussed in more detail later in the ACCP).

(3) A trapping mechanism (a mechanism that "seals" the reservoir and prevents the fluid from escaping).

b. Source Bed (the origin of oil). In discussing the source bed (beds that are rich in organic material), we must discuss the origin of oil because this is the phase in petroleum history in which the source bed is formed. The origin of petroleum has provoked extensive argument throughout scientific and engineering circles. As yet, a definite solution of the problem has not been found. The two most widely accepted theories by geologists and petroleum engineers are the inorganic and the organic.

(1) The inorganic theory attempts to explain the formation of hydrocarbons (petroleum) by assuming chemical reactions among water, carbon dioxide, and various inorganic substances (for example, carbides and carbonates) in the earth.

(2) The organic theory, on the other hand, assumes that hydrocarbons evolved from decomposition of vegetable and animal organisms that lived during previous geologic ages. In general, scientists have abandoned the inorganic theory as untenable. Conversely, the organic theory is supported by much geologic evidence.

c. Porous and Permeable Media. The earth consists of a potentially liquid core, a vitreous shell, and a crystalline crust. The earth's crust is composed of three main types of rocks classified according to their origin. The three types of rocks are:

(1) Igneous. These are formed from cooled lava.

(2) Sedimentary. These rocks are formed by the action of wind, water, and ice; from the accumulated deposition of the mineral remains of animals, from the deposits of evaporating land-locked seas, or from chemical reactions. Sedimentary rocks are the most common type that form petroleum reservoirs. Sedimentary rocks can be divided into two main classifications, clastics and carbonates.

(a) Clastic sediments are composed mainly of broken and worn particles of pre-existing minerals, rocks, and/or shells. Due to weathering, erosion, and transport, these particles are eventually deposited with organic debris in marine basins. This deposition is normally in successive layers. Clastic sedimentary reservoirs are characteristically sands or fine-grained silica.

(b) Carbonate reservoirs are characteristically limestone and dolomite. The framework of these firmations is chemically precipitated from seawater and/or removed from seawater by living organisms. Often fossil remains of these organisms are found in the framework. These sediments undergo various chemical processes, which alter and restructure the original sediment.

(3) Metamorphic. These rocks are either igneous or sedimentary rocks, which have been metamorphosed or transformed by extreme heat and/or pressure.

d. Porous and Permeable Rock.

(1) The three general rock types of significant importance to the formation of a petroleum reservoir are sandstone, limestone, and dolomite formations.

(2) It is believed that hydrocarbons generally move upward from their place of formation (the source bed) to their accumulation sites (the reservoir), displacing the seawater that originally filled the pore spaces of the sedimentary rock. The primary forces causing the migration of petroleum are buoyancy and capillary action.

(3) Potential reservoir rocks require three basic properties: porosity, permeability, and saturation.

(a) Porosity. This is the capacity of the rock to contain fluids. Porosity is normally expressed in percent, which represents the void volume of the rock divided by the bulk volume. The porosity of any given - reservoir depends on grain packing, grain sorting, cementation of the grains, grain angularity/roundness, and compaction.

1 Packing refers to the configuration in which the grains are geometrically arranged. Assuming grains me perfectly spherical in shape, a cubic packing (grains stacked directly on top of each other) can have a maximum porosity of 47.6 percent. Given grains of the same size and spherical shape but in a rhombic packing (grains stacked in the "hollow" formed by four other underlying grains), the porosity would be reduced to 25.9 percent.

2 Sorting refers to the sizes of the grains. "Well sorted" reservoirs have grains of uniform shape and size. "Poorly sorted" reservoirs have grains of different sizes and shapes. Obviously, a poorly sorted reservoir will have less porosity than the well sorted.

3 Cementation refers to the binding agent that holds the grains together. A well-cemented reservoir will have low porosity, and a poorly cemented reservoir will have high porosity.

4 Angularity or roundness of the grains will affect porosity due to the interlocking and subsequent filling of void spaces.

5 Compaction is the degree to which the overlying pressure alters the size and shape of the reservoir rock. Normally, due to the time stresses on the rock, porosity will be hindered.

(b) Permeability. This defines the ability of a reservoir to permit flow or passage of reservoir fluids.

(c) Fluid saturation of a rock. This is the ratio of the volume of fluid within the pores of the rock to the total pore volume. Fluid saturations are expressed as a percentage of pore volume. Very simply, a water saturation of 30 percent means that 3/10 of the pore space is filled with water. Water, oil, and gas may be found simultaneously in hydrocarbon reservoirs. However, due to gravity, fluids tend to segregate within the reservoir. The reservoir can be put into one of three classifications. These classifications are known as porosity, permeability, and saturation.

e. The Trapping Mechanism.

(1) As oil and gas are lighter that the ground water which permeates the porous rocks below the water table, it is evident that the upward movement of petroleum must be restricted in order for accumulations to form. A natural barrier, or trap, is the mechanism that allows a petroleum reservoir to form.

(2) There are many types of structural features that result in conditions favorable to the accumulation of hydrocarbons. The most common traps associated with petroleum reservoirs are: anticlines, salt domes, faults, and stratigraphic traps.

(a) In an anticlinal structure, the rocks comprising the crust of the earth are folded upward. The oil and gas are usually found on the crest of an anticlinal structure. An impervious cap rock must be present to seal the reservoir and prevent the escape of the gas and oil into higher layers. This cap rock, in one form or another, must be present in all reservoirs to contain the oil and gas within the structure.

(b) The salt dome is the result of the intrusion of large masses of salt into the sediments where they are found. This salt is believed to flow as a viscous semisolid when subjected to high pressure. This intrusion creates an upward pressure and results in the doming of the overlying sedimentary rocks. In this type of structure, oil accumulates within the upturned porous beds about the summit and flanks of the salt core.

(c) A fault is a region where two or more of the earth's tectonic plates meet. As the plates slide against each other, they may form a trap that allows a petroleum reservoir to form when a porous rock is brought into contact with an impervious layer.

(d) In the stratigraphic trap, the producing formation gradually pinches out for one reason or another and is overlaid by impervious rock. As a result, the oil, gas, and water can no longer migrate upward and is trapped.

f. The Search for Petroleum. While there are many methods of searching for petroleum to include geologic and geophysical means, the major concern of oil company exploration is the study of the sedimentary strata in a producing or potential petroleum province (basin).

(1) The petroleum geologist studies the composition, texture, fossil content, and thickness of the strata and the way they relate to one another. That is, their vertical succession and horizontal (lateral) extent and variability.

(2) On top of this, the geologist must know the way in which the strata were folded and faulted after deposition and the geologist must understand any flow of fluids now taking place in the rocks. The most important rocks, of course, are the known or potential reservoir rocks and the strata directly associated with them.

(3) The information for this “field mapping” comes from several sources.

(a) Surface geologic surveying can determine the subsurface structure of the rocks based on the geologic age of the rock, layers of exposed rock, and the angles at which the beds are formed.

(b) Subsurface geologic surveying is obtained from actual samples of the reservoir rocks obtained from wells already drilled, deep core wells, and sometimes, mining records. The samples can be studied under the microscope; comparing samples from different places will reveal lateral variability in the texture, mineral composition, organic components, and fluid

content of the reservoir rock. We can also examine the nature of the overlying "roof rock" and of potential source beds.

(c) Aerial and satellite photography can be used by the geologist to get an overall layout of the region being studied. The use of the stereoscope aids the geologist in determining where to take more detailed studies based on the "lay of the land."

(d) Geophysical Exploration methods are becoming the preferred method of field mapping and can take several forms.

1 Seismic. The Seismic method is most widely used. This method uses explosives to create underground sound waves and a seismograph to record the waves. By correlating the time it takes for sound to travel through the ground, geologists can determine the subsurface structure of the underlying rock layers.

2 Gravimetric. The Gravimetric method uses a gravitometer to measure the variations in gravity. Large masses of dense rock create a slightly higher gravity than lighter rock and can give the geologist a better understanding of the region's subsurface structure.

3 Magnetic. The Magnetic method uses a magnetometer to measure the magnetic fields in the rocks. This allows the geologist to determine a general idea of the structural formations of the region.

(e) All this information about the basin is put together on three types of diagrams: maps, cross-sections, and three-dimensional models. Each of these diagrams portray the nature and physical relationships of the rock units and rock fluids that seem important to the exploration effort. These diagrams must now be interpreted in a four-dimensional space frame, which involves the reconstruction of the successive events that gave rise to what we see today. These events include deposition of the sediments, their compaction, their changes upon burial, and the deformation or deformations, which the rocks then suffered. The ultimate aim is to understand the generation of hydrocarbons in the basin, the flow of fluids, and the accumulation of oil and gas. Armed with this understanding, the geologist attempts to predict the existence of undiscovered oil and gas pools.

g. Petroleum Production. Once a well has been drilled and completed in the manner dictated by experience and engineering design, it is ready to be produced. That is, the petroleum is removed from the ground. There are two types of production: primary production and enhanced recovery.

(1) Primary Production. Primary production is caused by the natural forces existent in the reservoir formation which drives the petroleum into the well bore. There are three types of "drives":

(a) Water drive. This drive is provided by the pressure of the water exerting an upward force on the oil zone of the reservoir. This will push oil toward the producing well which has a lower pressure. With time, water will occupy a larger portion of the reservoir as oil is produced and the pressure exerted by the water will be depleted.

(b) Gas cap drive. The typical oil reservoir has a zone of reservoir rock above the oil zone, which contains gas. This gas-bearing zone expands and exerts a downward force on the oil- bearing zone to force the oil to the production well. With time, this to will become depleted.

(c) Solution gas drive. Crude oil has a certain percentage of gas in solution, which is the result of great pressures under which the crude oil naturally exists. As the gas is released from the oil, it expands and forces the oil to the production well. This principle is best illustrated by taking a can of soda and shaking it up, then opening it. The carbon dioxide in the soda is released from the liquid and forces the soda out of the can.

(2) Enhanced Recovery. Enhanced recovery consists of two production types: secondary and tertiary.

(a) Secondary recovery. Once the natural forces are consumed in production, some outside force must be added to allow oil production to continue. Under the category of secondary recovery there are two methods to continue production.

1 Water flooding. In this method, water is injected into the formation through selected wells mid oil is removed from the surrounding wells until water production in the oil-producing wells becomes excessive. Various patterns are used for location of injection and producing wells to maintain the most efficient operation.

2 Gas injection. In this method, gas is injected into the gas cap of the formation to maintain pressure on the oil-bearing zone. By maintaining the pressure above the oil zone, production can continue.

(b) Tertiary recovery. The listing of various tertiary/enhanced oil recovery techniques, which follows, includes the more common methods, which were practiced and are being investigated. The degree to which these methods are currently studied has been greatly reduced in view of the low cost per barrel of crude. We will briefly discuss three thermal methods and the concept of using miscible fluids.

1 In-situ combustion produces heat energy by burning some of the oil within the reservoir rock itself. Air is injected into the reservoir, and a heater is lowered into the well to ignite the oil. The resulting combination of gas, steam, and hot water moves the oil from the injection well to the producing wells.

2 Steam stimulation (Huff and Puff). This thermal method used each well as both the injection and the production well. First, high pressure steam is injected directly into the production zone for several days or weeks. After injection, the reservoir area around the well is allowed to soak for additional days or weeks. After the soak period, the well is brought into production to recover the heated and thinner oil and hot water.

3 Steam flooding uses separate injection wells and production wells to improve both the rate of production and the amount of oil that will ultimately be produced. Heat from the injected steam reduces the viscosity of the oil as the injected fluid drives the oil from the injection well to the production well.

4 Miscible displacement. The miscible nature of fluids refers to the ability of certain fluids to mix together. Fluids that are miscible with oil are much more effective than either water or gas to drive in displacing oil from the region they contact. Light hydrocarbons, carbon dioxide, and nitrogen have shown the most promise, but these still require extensive research and field-testing.

h. Reservoir stimulation methods. After all recovery methods have been economically exhausted, the petroleum engineer can attempt to recover any remaining oil in place through stimulation techniques. Stimulation is altering the properties of the petroleum reservoir such that the oil is allowed to move more freely. Two means of stimulation are:

(1) Acidizing consists of pumping anywhere from 50 to thousands of gallons of acid down the well. The acid travels down the tubing, enters the perforations, and contacts the formation. Continued pumping forces the acid into the formation where it etches channels. These channels provide a way for the formation's oil to enter the well through the perforations.

(2) Hydraulic fracturing involves pumping a specially blended fluid down the well and into the formation under great pressure. Pumping continues until the formation literally cracks open. Proppants (sand, walnut hulls, or aluminum pellets) are mixed into the fracturing fluid. These enter the fractures in the formation. When pumping has stopped and the pressure has been allowed to dissipate, the proppants hold or prop the fractures open to allow passage for the oil.

LESSON 19

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson that contains the portion involved.

1. What are the three types of primary production?

   A. Petroleum drive, aeration, and resolution drive
   B. Water drive, gas cap drive and solution gas drive
   C. Primary production, enhanced recover, and secondary recovery
   D. Water drive, solution gas drive, and enhanced recovery

2. Which of these sedimentary rocks is more likely to form a petroleum reservoir?

   A. Sandstone
   B. Shale

LESSON 19

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	B. Water drive, gas cap drive, and solution gas drive (page 19-6, para. 1.g 1.a).
2.	A. Sandstone (page 19-3, para 1.d.1).

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LESSON 20

PETROLEUM REFINING AND PROCESSING

Critical Tasks: 01-5103.30-2075
03-5103.00-0088

OVERVIEW

LESSON DESCRIPTION:

In this lesson plan, you will obtain a general knowledge of petroleum properties and refinery operations. You will also learn about planning and the importance of knowing about all available fuel assets.

TERMINAL LEARNING OBJECTIVE:

ACTION: You will learn about the three major refining processes, the three methods of separation, the seven methods of conversion, and the treatment process.

CONDITIONS: Using the corresponding lesson and listed references.

STANDARDS: With at least 70 percent accuracy IAW NAVEDTRA 10883-B.

REFERENCES: NAVEDTRA 10883-B

INTRODUCTION

Careful planning is required to meet the daily demands of a nation that depends on petroleum for three-fourths of its energy supply, and to meet the increased demands in case of an emergency. One of the major problems in World War II was meeting requirements for high grade aviation gasoline. As a result, the production of motor gasoline was curtailed and civilian gasoline rationing instituted. While wartime changes in refinery yields results in sacrifice on the part of civilian consumers, this ability to change the yield of a barrel of crude is a distinct advantage in planning and meeting requirements. As a petroleum officer, you will not be responsible for the conversion of civilian refineries for military use; however, you will be responsible for letting your "boss" know of this important asset in planning fuel support. As such, you need a general knowledge of petroleum properties and refinery operations.

1. General Properties of Petroleum.

a. Petroleum is a mixture of naturally occurring hydrocarbons which may exist in solid, liquid, or gaseous states, depending upon the conditions of pressure and temperature to which it is subjected. Almost all of the petroleum produced from the earth is either liquid or gas, and commonly, these materials are referred to as either crude oil or natural gas. Crude oil is the material most sought after of these naturally occurring hydrocarbons.

b. Crude petroleum is a complex mixture of various chemical compounds, commonly known as hydrocarbons. A typical hydrocarbon consists of:

(1) 11 to 13 weight percent hydrogen.

(2) 84 to 87 weight percent carbon.

(3) Traces of nitrogen, sulfur, oxygen, and helium may be found as impurities in crude petroleum. A low sulfur content results in a "sweet" crude oil and a high sulfur content is classified as a "sour" crude oil.

(4) Although all petroleum is constituted primarily of carbon and hydrogen, the molecular constitution of crude oils differs widely. About 18 series of hydrocarbons have been recognized in crude petroleum. Of these series, the most commonly encountered are the parrafins, napthenes, olefins and aromatics.

(a) Parrafins are hydrocarbons that are richest in hydrogen and the most stable hydrocarbon. There are two types, straight-chain parrafins and branched-chain parrafins. Of the two types, the branched-chain parrafins are preferred for their higher octane number and anti-knock characteristics in gasolines.

(b) Napthenes are closed-chain hydrocarbons, generally very stable and are primarily found as a component of lubricating oils.

(c) Olefins are characterized by having at least one double bond between some of the carbon atoms. This means that at least two carbon atoms are joined with each other rather than a hydrogen atom. As with paraffins, olefins can be either straight chained or branch-chained molecules. Because of their double bonds, olefins are highly reactive with other elements and make them unsatisfactory for use in fuels that need a high degree of stability. However, olefins are an essential part of petrochemicals such polypropylene and butyl rubber, used in tire inner tubes.

(d) Aromatics are characterized by at least one six-membered ring of carbon atoms. These molecules are known as aromatics because of their pleasant odor. Aromatics are naturally occurring in crude oil and are desired for gasolines because of their anti-knock qualities. However, the aromatics also tend to dissolve some types of rubber. Aromatics such as toluene were used during World War II to manufacture TNT and aviation gasolines. Today, toluene is used in solvents ad other petrochemicals.

(e) No two crude oils are alike. Even crude oils taken from different wells in the same oil field can differ significantly. Therefore, a method of classifying crude oils was designed. The simplest and most widely accepted system classifies crude oils according to the relative quantities of parrafin and asphalt. There are three classifications:

- Parrafin base
- Mixed base
- Asphalt base

(f) Another method of classification is according to a crude oil's physical properties. Of these, the most important properties for classification are the density and the viscosity. Since the density of a liquid is a function of temperature and pressure, it is necessary to designate standard conditions for reporting density and, hence, specific gravity ad API gravity.

The petroleum industry has adopted as standards a temperature of 60°F and a pressure of 14.7 PSI (atmospheric pressure).

(g) It should be noted that as the density increases, the boiling point increases. This is an important concept to remember in discussing refinery operations by separation. In other words, the more dense (the heavier) the hydrocarbon compound, the greater the temperature required to produce vapor from liquid.

2. Petroleum Refining.

a. Refining is essentially a manufacturing industry, using crude petroleum as its raw material to make numerous petroleum products. Hundreds of thousands of wells furnish the crude oil to the relatively few refineries which process the oil into more than 2,500 products which are then distributed through several hundred thousand markets outlets to millions of customers. To ensure that the entire process runs smoothly and that demands for petroleum are met, oil is kept constantly on the move from the well to the consumers. Refineries operate day and night -- a classic example of continuous flow operations.

b. Although many different processes are used in refining, only the major ones are discussed here. The major processes are separation, conversion, and treatment.

3. The Separation Process.

Separation processes are physical processes employed to segregate the hydrocarbons in crude oil according to either boiling range or hydrocarbon types. There are three separation processes: factional distillation, absorption, and solvent extraction. Distillation is employed in all cases as the first step in refining. Absorption and solvent refining are secondary steps which may or may not be applied, depending on the end product desired

NOTE: Of all three-separation processes, factional distillation is the most common. At atmospheric temperature, water boils at 212°F.

4. Fractional Distillation.

The process of distillation is simply heating the crude oil to form vapors and condensing the vapors to liquids. Since crude petroleum is a mixture of many complex hydrocarbons, all of which have different boiling points, not one but several distillations are necessary. By the process of distillation, the various hydrocarbon compounds in crude oil can be separated into groups of hydrocarbons (factions or cuts) having similar boiling ranges. To effect the separations required in modem petroleum refining, these distillations are carried out as a continuing process in which a stream of heated crude oil is continuously charged to a fractionating tower and the vapors and liquids continuously withdrawn.

a. The first distillation takes place at atmospheric pressure. In this process, the light ends (fractions having the lowest boiling point) are drawn off. This process is frequently referred to as striping because the crude is stripped of its more volatile components. The first distillation produces fractions used in the following petroleum products:

- Liquid petroleum gases (propane and butane).
- Motor gasoline.
- Kerosene and jet fuels.

- Heating oil and diesel fuel.

- The residue from this distillation is then ready for further processing.

NOTE: At atmospheric pressure, crude oil boils at 150°, 450°, 750°, and 950°F. Each of those boiling points produces vapors of different hydrocarbon molecules or "fractions." This is the theory behind factional distillation.

b. The residue from the first distillation undergoes a second distillation process which is performed in a vacuum because of the extreme temperatures needed to separate the remaining fractions. If the distillation was carried out under atmospheric pressure, the temperatures required to separate the remaining fractions would result in hydrocarbon molecules being "racked," which is not desired at this time. The vacuum distillation produces fractions that are used in the following petroleum products:

(1) Lubricating oils.

(2) Greases.

(3) The residue from this process is known as residuum and is processed as residual fuel oils.

(4) Depending on the desired product each of the fractions may undergo more distillations in the refining process.

5. Absorption.

The absorption process uses an absorption material to absorb unwanted compounds and allows the remaining compounds to be separated.

a. The oil to be treated is pumped into an absorption tower.

b. The oil passes through the absorption material, which absorbs the unwanted compounds such as sulfur, nitrogen, and other compounds.

c. The absorption material can be treated to remove the unwanted compounds and used again.

d. The remaining oil will go to another distillation tower for further processing.

6. Solvent Extraction.

This process is similar to absorption, but uses a liquid solvent to extract hydrocarbon compounds. Solvent extraction is used in refining lubricating oils and other oils for specialized purposes. Solvent extraction is also used for separating specific compounds such as bezene, toluene, and xylene from complex mixtures.

a. The solvent is mixed with the oil to be processed and is allowed to react with the oil.

b. The mixture is separated into two fractions.

(1) That portion of the oil which remains undissolved and is not removed by the selective solvent is called raffinate and is processed as lubricating oils.

(2) The material removed with the solvent is called extract and is sent out of the lubricating oil system for other uses.

(3) Many different solvents are employed in the petroleum industry, the choice of the specific solvent depends upon the compounds to be extracted.

7. Conversion Processes.

Most of the components separated by the distillation of crude oil must undergo certain conversion processes before they become marketable products. In the conversion processes, the ratio of carbon to hydrogen is changed and the size and arrangement of the hydrocarbon molecules are altered. Desired conversion may be accomplished by employing one or more processes. These processes include:

a. Cracking. Cracking is the process of subdividing large hydrocarbons molecules into smaller ones. When molecules are heated, the effect is to weaken the grasp that one atom has on another. If the temperature is sufficiently high and is maintained in that condition long enough, it is possible to break some of the mutual bonds between the carbon atoms. This results in the breaking up or cracking of the original molecule into two or more smaller molecules.

(1) Commercially, the purpose of cracking is to increase the yield of gasoline per barrel of crude by subdividing large hydrocarbon molecules to form the lighter hydrocarbon molecules of gasoline and to improve the quality of gasoline.

(2) Cracking is accomplished by means of heat. The rate and severity of cracking is a direct function of the temperature to which the oil is raised by application of heat and the time allowed for the reaction. The reaction may be accelerated by the use of a catalyst. Pressure is used in cracking units to confine the volume of oil and vapors to manageable size. Pressure does not accomplish cracking; in fact, it has a slight tendency to suppress cracking and a definite tendency to promote polymerization (the opposite of cracking) of the products of the cracking reaction. By careful control of the temperature at which the cracking reaction is carried out, the maximum of desirable constituents can be produced. Extremes of temperature and time would convert any oil to light gases and coke.

b. Thermal Cracking. A cracking process using only temperature and time is called Thermal Cracking. When a catalyst is added, the process is called Catalytic Cracking. A catalyst is a substance which will influence a chemical reaction without being changed itself.

(1) In thermal cracking, the charge stock is subjected to intense heat and pressure for a period of time. Normally, this process operates at a temperature of approximately 900°F and under a pressure of 200 to 750 PSI.

(2) Thermal cracking produces a mixture of hydrocarbons that closely resembles crude oil with respect to boiling range. The mixture is distilled right in the cracking unit, and those parts of the mixture which are not desired for finished products are returned to the cracking zone so that the net products are:

(a) Dry gases (methane and ethane).

(b) Liquid petroleum gases (essentially propane and propylene).

(c) Cracked gasoline.

(d) Either heavy fuel oil or coke.

c. Catalytic Cracking Process. In the catalytic cracking process, several different materials are used as catalysts, but the most common is a fine sand-like porous material. As cracking takes place, carbon is deposited on the surface of the catalyst. This carbon is burned off after which the catalyst can be used again and again. The removal of carbon from the catalyst is known as regeneration. 'The catalyst flows continuously between the two process stages of reaction and regeneration, propelled by gases. Because the catalyst flows like a liquid, the process is called fluid catalytic process.

(1) A single hydrocarbon molecule can be cracked into smaller molecules that produce a greater volume of material than the original molecule. This increase in volume is the result of changing the molecular structure of the hydrocarbons.

(2) In 1909, one barrel of crude oil produced these fractions. You can see that only 11 percent of the volume became gasoline. Through the cracking process, refineries can now produce more than three times the 1909 yield of gasoline.

d. Polymerization. Whereas the process of cracking breaks down large, complicated molecules into, simpler ones, the process of polymerization combines small molecules into larger ones. Specifically, light olefins are combined to form hydrocarbons of high molecular weight. Thus, the refiner uses byproduct gases to produce a wide variety of products ranging from liquids used as blending in gasolines, to solids which can be used as plasticizers. Polymerization of propylene and butylene in a mixture to produce a constituent of motor gasoline is the most common polymerization operation. The process most commonly used employs phosphoric acid as a catalyst. The product of the reaction is a mixture of heptenes and other olefins.

e. Alkylation. Alkylation, like polymerization, is a process whereby hydrocarbons are combined. In the alkylation process, however, paraffinic hydrocarbon (generally considered nonreactive) is combined with an olefin to produce a paraffin of branched structure, a highly desirable component of both automotive and aviation gasolines. The result of this combination is known as alkylate. The help of a catalyst is necessary to bring about the reaction.

(1) The process of alkylation makes possible the combination of some of the natural and stable light hydrocarbons with the less stable gases produced by cracking. This process was developed during World War II to increase the availability of source materials required for the manufacture of aviation gasoline. At that time, the process was used primarily to produce aviation alkylate from isobutane and butylene; but propylene, ethylene, and pentylene can also be alkylated with isobutane.

(2) There are two types of alkylation processes in wide use:

- Sulfuric acid process
- Hydrofluoric acid process

f. Hydrogenation. The hydrogenation process adds hydrogen to the hydrocarbon molecule. Hydrogenation may be either nondestructive or destructive. In the former, hydrogen is added to the molecule only if, and where unsaturated with respect to hydrogen exists. The boiling range of the product resulting from nondestructive hydrogenation, is substantially the same as that of the charge stock. Nondestructive hydrogenation is usually carried out at pressures ranging between 200 and 400 PSI. Destructive hydrogenation requires much higher presses. Catalyst is required for both types of hydrogenation.

(1) Nondestructive hydrogenation processes are extensively used in the United States. The product of nondestructive hydrogenation has a boiling range little changed from the boiling range of the charge stock. The important changes are:

(a) Napthenes are converted to aromatic hydrocarbons which are highly desirable for high performance gasolines.

(b) Olefins are converted to paraffins which are less susceptible to oxidation, reducing the danger of gum formation in the product.

(c) Sulfur has been reduced.

(2) Destructive hydrogenation can be described as hydrogenation accompanied by cracking. As cracking occurs, hydrogen adds itself to the chains where the rupture occurs. The product of destructive hydrogenation may be lighter than the material charged to the process.

g. Dehydrogenation. Dehydrogenation is the reverse of hydrogenation. In this process, hydrogen is removed form adjacent carbon atoms of an organic compound with resultant formation of a double bond. Commercial processes now in operation are both catalytic and thermal, and are used principally to dehydrogenate saturated gaseous hydrocarbons to produce starting material for the alkylation process.

h. Isomerization. Isomerization processes have been developed by the petroleum industry to convert straight-chain hydrocarbons to the valuable branched-chain hydrocarbons which increase the antiknock properties of gasolines. This conversion is brought about in the presence of a catalyst, usually a moderate temperatures and pressures. In petroleum refining, the isomerization process is applied principally to butane and pentane. The object of isomerizing butane is to obtain isobutane for alkylation and other uses; that of pentane isomerization, to obtain isopentane for blending into gasoline.

i. Reforming. Reforming is a cracking process employed for the upgrading of stocks, with low octane number. It may be either thermal or catalytic and may be mild or severe, depending on the desired end.

(1) Mild reforming is applied to stocks with a boiling range identical or very similar to gasoline. The application of high temperature converts some paraffins to olefins, changes some straight-chain molecules to branch-chain molecules, breaks alkane sidechains from alkan-naphthenes to form aromatic hydrocarbons, and may isomeize some compounds.

(2) Severe reforming is often applied to heavy gasolines with a boiling range of 200-400°F. Enough of the heavier material is cracked to give a finished product with a normal gasoline boiling range. The reactions are the same as in mild reforming except that there is more cracking.

(3) In both thermal reforming and catalytic reforming, the reactions described above take place. In catalytic reforming, the order of the reactions is changed since the catalyst promotes certain reactions and does not affect others so readily. Thus, the dehydrogenation of naphthenes is much more rapid in catalytic reforming than it is in thermal. Also, hydrogen may be recycled in catalytic reforming to bring about a higher degree of sulfur reduction and to convert olefins to paraffins. Catalytically reformed gasoline is thus usually much more saturated (with hydrogen) than is thermally reformed gasoline. Thermal reforming has been largely displaced by the catalytic process.

j. Treatment Process. The purpose of the treatment processes is to remove sulfur and other harmful elements from crude oil. If these elements are not removed, the resulting products can produce noxious and corrosive fumes. The treatment process converts these harmful elements into harmless, odorless substances.

LESSON 20

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. Which of the three methods of separation is the most commonly used?

   A. Fractional Distillation
   B. Solvent Extraction
   C. First Distillation
   D. Absorption

2. Which of the conversion processes uses heat and/or catalysts to break large hydrocarbons into smaller ones?

   A. Dehydrogenation
   B. Reforming
   C. Cracking
   D. Polymerization

LESSON 20

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer ad Feedback
1.	A. Fractional Distillation, (page 20-4, para 4a, note).
2.	C. Cracking, (page 20-6, para 7a(2) and 7b).

LESSON 21

PETROLEUM INDUSTRY

Critical Tasks: 01-5103.30-2120
03-5103.00-0078
03-5106.00-0135

OVERVIEW

LESSON DESCRIPTION:

In this lesson you will learn about the early use of petroleum; the functions of an integrated petroleum company; and alternate sources of energy.

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe the early uses of petroleum, the functions of an integrated petroleum company, and alternate sources of energy.

CONDITIONS: Using the corresponding lesson plan and cited references.

STANDARDS: With at least 70 percent accuracy IAW NAVEDSTRA 10883-B.

REFERENCES: NAVEDSTRA 10883-B.

INTRODUCTION

As petroleum officers, you will at some time in your career, have the opportunity to interact with your civilian counterparts in the petroleum industry. Whether it be in a wartime situation, working as a quality assurance officer, or in a training with industry program, you need to be familiar with the industry and its origins. Therefore, it is appropriate that we focus on the origins of the petroleum industry, its major function and the impact that energy has on society.

1. The Historical Use of Petroleum.

The use of oil and its various derivatives can be found throughout history. Examples include:

a. Seepages of oil and natural gas are believed to have furnished fuel for "sacred" fires worshipped by primitive peoples who ascribed divine powers to the flames.

b. It is believed that Noah in Mesopotamia used oil and natural gas seepage to furnish pitch to caulk the ark (thereby making the vessel watertight).

c. Pitch was used as axle grease for chariots of the Pharaohs in Egypt.

d. The Greeks destroyed a Scythian fleet by pouring oil on the sea and setting it on fire (Scythian: ancient nomadic people who inhabited Scythia adjacent to the Black Sea).

e. Early records in China indicate the use of both oil and natural gas.

f. Early American use of petroleum:

(1) The first use of petroleum in America dates back to the Indians who obtained oil by skimming it from the surface of springs and streams (it appeared as a thick, scummy substance).

(2) Early Americans dating from the colonists to the first half of the nineteenth century had only the fatty tissue of animals (tallow) from which candles were made ad whale oil for light. Whaling became a major industry as New England ships combed the seas. Over the years, the supply of whales became scarce ad the need for an alternate source of fuel became obvious.

(3) During the early 1850s, some oils for illumination were being distilled from coal and petroleum skimmed off ponds and streams.

(4) The beginnings of the petroleum industry in the United States, as we know it today, occurred in Titusville, PA in August 1859 when COL Edwin Drake successfully drilled the first oil well in America. The successful drilling of petroleum led many to believe that an endless supply of economic energy had been discovered. It was soon after that the oil boom began in America and the first refinery was put into operation (1861). Refineries initially concentrated on the production of kerosene (an odorless, smokeless illuminate), greases, and lubricating oils.

g. The use of petroleum by the military in America:

(1) The use of petroleum products by the United States Armed Forces can be traced back to the Revolutionary War when coal ad kerosene were purchased to keep Washington's soldiers warm in the winter.

(2) Prior to World War I, mechanized warfare had not yet come into its own and the requirements for petroleum products were relatively small and easily filled.

(3) During World War I, the tank made its first major appearance on the modem battlefield. Fewer than 200,000 barrels of oil products were supplied daily to the allied forces, but even with this limited use of petroleum, its impact on the war effort was realized by both sides.

(a) Realization of its importance was stated best by Lord Cruzon who, after the armistice in 1918, said, “The World War was won for the Allies not by blood, but by oil.”

(b) More significant was the confession of Germany's military strategist, General Lundendorff, who, in his memoirs stated, “It was chiefly because of insufficient oil reserves in the World War that the German General Staff was forced to sue for peace.”

(4) After World War I, the Army increased its dependence on petroleum products when it began to mechanize its forces.

(a) Quartermaster officers in the 1930s, foresaw the future importance of petroleum and a rapid distribution system for it advocated pipelines as a supplement to the truck and rail systems that were then being used.

(b) On 26 February 1942, the War Department, acting on a request by the Invasion Planning group of the European Command, approved a new gasoline dispensing system submitted by the Quartermaster Corps: A pipeline system in which all pipe, pumps, engines, hose, tools, and quick couplings were of standard commercial design.

(5) With the advent of World War II, the importance of petroleum was further highlighted.

(a) Military experts are of the opinion that during the war, the Germans entered Romania and southeastern Europe to obtain the oil required for their war machine, and may have attacked Russia to capture the oil fields in the Caucasus.

(b) Japan, short of oil supplies, directed her initial attacks to obtain, among other vital commodities, the rich oil fields of the East Indies.

(c) The Allied strategy sought to deprive both adversaries of petroleum supplies as quickly as possible. Fuel depots and refineries were primary bomber targets and tankers were targets of choice for our submarines.

(d) Likewise, the German submarines concentrated on Allied tankers in the battle of the Atlantic, creating a precarious situation in the early days of World War II. The volume of liquid fuel shipped overseas during the war was nearly 16 times the amount of food.

(e) Petroleum distribution consisted of packaged fuels in 5-gallon cans and 55-gallon drums. These drums were filled in fuel depots from bulk stocks, loaded into cargo trucks, and shipped to the combat forces. This method-of distribution was obviously not the most efficient, but in the end, a high enough priority was placed on fuel to meet the needs of the force.

(6) The importance of petroleum products in modern warfare continued to increase. In the Korean War, 60 to 65 percent of all supply tonnage consisted of petroleum products. This higher consumption rate exceeded all planning estimates and continued to grow throughout the conflict.

(a) Petroleum logistics was made even more difficult because of the great temperature fluctuations from summer to winter on the peninsula. During the winter, diesel consumption increased 1300 percent over summer consumption.

(b) Distribution, as in World War II, was almost exclusively by packaged products with only minor use of pipelines. The majority of the supplies were received in bulk by tanker, off-loaded to nearby depot, and then packaged in 55-gallon drums for further movement forward. However, by 1953, a small system of 41 pipelines, approximately 320 miles long, assisted in petroleum distribution in Korea.

(7) During the Vietnam conflict, initial petroleum support was provided by commercial oil companies.

(a) At the height of the Vietnam War, the Army operated and maintained seven separate pipelines totaling over 271 miles.

(b) The extensive se of pipelines helped with the distribution of more than 3 million gallons of fuel per month.

(8) During Operations Desert Shield and Storm, U.S. forces consumed over 2.5 billion gallons of bulk petroleum. This was accomplished through the use of Military Sealift Command and commercial tankers, the Inland Petroleum Distribution System, host nation support, military tank vehicles and petroleum units with collapsible storage tanks.

(9) As the modern battlefield continues to evolve, petroleum and its effective distribution is recognized as one of the critical paths to success in an offensive scenario. On an integrated Airland Battlefield with the extensive use of land vehicles, aircraft, and watercraft, modem warfare requires not only tremendous quantities, but, also a supply system that can provide those fuels where they are needed when they are needed. The biggest challenge for the petroleum officer is to provide a logistical tail that can keep up with the offensive thrust so that we can continually press the enemy. This requires a constant review and updating of doctrine and equipment as lessons are learned.

2. The Integrated Petroleum Company: The beginnings of the petroleum industry can be traced back to John D. Rockefeller.

a. Rockefeller, Maurice B. Clark, and Samuel Andrews formed a partnership in 1862 to operate a small refinery in Cleveland, Ohio. Out of these small beginnings, the Standard Oil Company was to be formed about 10 years later. The company eventually reorganized into Standard Oil Trust, the first integrated oil company.

b. There are four primary functions of the integrated oil company: production, refining, transportation and marketing.

(1) Production.

(a) The production branch of the industry is concerned with the science and mechanics of exploring for new oil fields, drilling wells, and actually bringing the oil to the surface.

(b) Production is the process of recovering petroleum fluids from their underground reservoirs and preparing those fluids for transportation to the refineries. The two fluids that are generally produced from a reservoir are crude oil and natural gas.

(c) Production also includes getting the fluid ready for transportation and sale to a refinery. This is accomplished through a gathering system which collects the fluids produced at all the wells in an oil field and brings them together at a production platform.

(d) At the production platform, the fluid is processed. The process accomplishes the following:

1 Removes water from the fluid through the use of settling, chemicals, electrical current, and/or heat treatment. The type of processes used depends on how emulsified or mixed the oil and water are.

2 Separates the natural gas from the crude oil. The crude oil and natural gas are separated tough a series of separators operating under different pressures or temperatures such that the lighter gases are extracted from the top of the separator and the fluid is extracted from the bottom. This string of vessels is called the separator train.

3 The natural gas extracted during this treatment can be sold, injected back into the ground to increase the pressure in the reservoir, or used on the platform to provide the energy needs of the site. The crude oil is put into storage tanks pending sale of the product.

(2) Refining. Reining is the process of preparing the product for sale to the consumer. From the crude oil, several products can be made to include automobile fuels, aircraft fuels, lubricants, and other petroleum products. There are two basic refining processes:

(a) Separation is the basic process of separating the oil into its primary fractions. The initial stage in refining is fractionation. The most widely used method of fractionating is called distillation. Distillation is similar to what you do when you put a pot of water on to boil. Crude oil enters a boiler or container and is heated at different temperatures. During this process, different vapors are recovered and condensed for use as different products.

(b) Conversion is changing petroleum factions to a more desirable state. To produce the best quality of the preferred products in greater quantities, more advanced conversion methods have been developed.

(c) Some of the historical developments in refining include:

1 In 1913, Dr. William M. Burton built the first cracking still which produced a gasoline product far superior in antiknock characteristics.

2 In 1921, Dr. Thomas Midgely discovered that a small amount of tetraethyl lead added to gasoline would reduce engine knock, increasing the power and efficiency of engines.

3 In 1937, Eugene Houdry introduced catalytic cracking which further increased the yield of gasoline from each barrel of crude oil processed and improved the quality of the fuel. As a result of oil company research, hundreds of other new and improved products began to appear during this period.

(3) Transportation. Modem transportation for petroleum products consists of multiple modes to move both crude oil and finished products. Pipelines, oil ongoing tankers, canal and river barges, railroad tank cars and highway tank trucks are all part of the petroleum transportation network. If possible for use, the pipeline is the most economical way of transporting large volumes of petroleum at one time.

(a) Early transportation consisted of movement of oil in wooden barrels. To supply refineries located a distance away, Coopers (makers of barrels) worked overtime making barrels for crude oil. Thousands of teamsters churned roads into quagmires as they lurched and splashed toward the nearest railroad. At first, the barrels of oil were transported on flat cars and rafts. This was an inefficient, slow method of moving oil.

(b) In 1865, a railroad tankcar was built for carrying petroleum. That same year, the first oil pipeline was laid. It was 5 miles in length. Teamsters and railroad men saw themselves being replaced by a formidable new competitor. Fights and court battles followed, until finally pipelines established their right to operate under law.

(c) In 1879, the first major pipeline was completed. It extended 1 10 miles across the Allegheny Mountains to Williamsport, Pennsylvania, and was regarded as the engineering marvel of the age.

(d) Since then, pipelines have become a major part of the petroleum industry. They serve as a means of gathering and transporting the crude oil and natural gas produced in the field to the production platform, moving the gathered fluids from the production platform to refineries, and they also serve to carry finished products from the refineries to the wholesalers.

(e) Control in pipeline operation is a vital part of the industry, just as it is in most businesses. The methods of control for oil pipeline listed below are simple.

1 Scheduling: An itinerary of deliveries.

2 Dispatching: The process of executing the schedule.

3 Testing: A means of recording the buying and selling of crude oil using a run ticket.

(4) Marketing: The marketing end of the oil business is engaged in the sale and distribution of oil products to consumers who range from industrial users to homeowners. The major responsibilities of the marketing end of the oil business are similar to those of any other business and include:

(a) Sales.

(b) Financial management.

(c) Advertising. Advertising traditionally has been through newspapers, magazines, television, and radio.

(d) Distribution.

(e) Research.

(f) Planning. The planner is concerned with three basic periods of time; the present, the near future, and the distant future. In any project, planning is essential and several factors must be considered:

1 Having an assured supply of raw materials: Not too much and not too little is ideal. Industry must gauge future demands accurately to avoid creating a serious imbalance.

2 Planning for shutdown and seasonally: Refining facilities cannot operate continuous without shutting down periodically for maintenance. These interruptions must be planned to provide a continuous flow of products to customers. Thus, for example, refineries frequently shut down major gasoline-making plants in the winter when the demand for gasoline hits a seasonal low.

3 Meeting changing demands: Industry is continually confronted with changing demands both seasonal (for example, for home heating oil) and long-term (for example, for jet fuel). Companies must be prepared to make these shifts at the proper time.

4 Obtaining good forecasts: This requires good communication between customer and supplier. Industry encourages customers to do a good job of planning and announcing specific needs as far in advance as possible. This is especially true of military requirements since the Department of Defense is industry's single biggest customer.

3. United States Energy Strategy.

a. The United States was for many years the leading oil producing country in the world. In 1982, was third behind the Soviet Union and Saudi Aria in production. The United States is without question the world's largest consumer of petroleum and must import 40 percent of the oil it uses.

b. The embargo of petroleum supplies by the OPEC started in the winter of 1973 and demonstrated to the United States the need for an emergency oil storage program.

c. The shortage resulting from the embargo caused severe impacts on our economy and emphasized our vulnerability to oil imports.

d. In December 1975, the U.S. Congress passed the Energy Policy and Conservation Act which established the Strategic Petroleum Reserve and authorized the storage of up to 1 billion barrels of oil. The SPR is not for military use; it was established to provide a source of crude oil for commercial use in the event of another major oil embargo.

e. Work on the acquisition of salt cavern sites close to major oil distribution networks, and their preparation to hold oil began in 1976. By early 1979 when the program was stopped the reserve held 91.7 million barrels. However, work on cavern sites preparation continued.

f. In 1980, after almost two years of inactivity in the purchase program, Congress passed the Energy Security Act. Under the ESA, the United States could resume filling the SPR at an annual rate of at least 100,000 BPD. Congress's FY 81 appropriation bill stated that the President will seek to fill the SPR at a minimum of 300,000 BPD.

g. Fill goals for the SPR, starting with an inventory of 252 million barrels in FY 81, were 278 million barrels in FY 82 and a total of 750 million barrels in FY 89.

h. In addition to the Strategic Petroleum Reserve, the United States has attempted to reduce its dependence on foreign energy by looking for new energy sources.

(1) Oil company scientists and engineers have worked for years to develop synthetic petroleum from oil shale, tar sands, and coal.

(2) Several oil companies are leading the way in oil shale research by putting their geological and chemical experience to work on research and development projects. For example, oil companies are involved in all the major ongoing oil shale projects.

(3) Research into tar sands in the United States is being conducted by the Federal government and several oil companies. Tar sands are a mixture of clay, bitumen, sand, water, and sulfur.

(4) Coal can be turned into fuel gases and liquids. Although the processes are presently uneconomical, research and development programs have been and are now being funded by the Federal government and private industry, including several oil companies. Coal is also being transported in “slurry” form from mine to the preparation plant.

(5) Many companies are doing research on new sources of energy including solar, nuclear, geothermal, tidal, and wind power. Because most of these sources of energy are still in the developmental stage, the cost of producing energy from them makes them economically impractical.

(6) The price increases imposed upon the world by OPEC oil-producing nations in 1979 and 1980 contributed to conservation and the largest op ever experienced in American petroleum consumption. Many of the efficiency improvements are structural in nature--new cars, home appliances, and factories that are far more energy efficient than the ones they are replacing.

i. Another step taken to reduce this country's dependence on foreign energy was the deregulation of the United States petroleum industry.

(1) Deregulation allowed the petroleum companies more flexibility in research and development, exploration, and drilling.

(2) It started when President Carter took a crucial positive step by gradually removing government price and allocation controls from crude oil (controls which had begun in August 1971).

(3) President Reagan completed the decontrol process in January 1981. The effects of oil price decontrol, particularly at a time when OPEC was once again raising world prices, were starting. After many years of frustration in developing domestic progress, drilling for oil reached record levels and domestic oil production increased.

j. Despite recent progress, imported oil still represents nearly one-third of total U.S. oil supply. The long term U.S. energy outlook remains unsettled despite considerable domestic energy progress and the adequacy of current world supplies. Oil continues to account for about one-half the energy Americans use. DOD projections show the United States can continue to produce crude oil at a rate of about 8 million BBL per day until 2000. Thereafter, oil supplies will be harder to find and more costly to produce.

LESSON 21

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What are the two basic processes of refining?

   A. Separation and Transportation
   B. Production and Marketing.
   C. Separation and Conversion
   D. Production and Conversion

2. What is the SPR and what is its purpose?

   A. The SPR is the Strategic Petroleum Reserve which was authorized by Congress in 1975 for the purpose of reducing the United States vulnerability to embargoes of foreign oil.
   B. The SPR is the Supply Petroleum Refinery which was authorized by Congress in 1975 for the purpose of reducing the United States vulnerability to embargoes of foreign oil.
   C. The SPR is the Strategic Pumping Reserves which was authorized by Congress in 1975 for the purpose of reducing the United States vulnerability to embargoes of foreign oil.
   D. The SPR is the Supply Petroleum Refinery which was authorized by Congress in 1975 for the purpose of providing crude oil for Host Nation Support.

LESSON 21

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. C. Separation and Conversion, (page 21-5, para 2b(2)).

2. A. The SPR is the Strategic Petroleum Reserve which was authorized by Congress in 1975 for the purpose of reducing the United States vulnerability to embargoes of foreign oil. (page 21-7, para 3d).

LESSON 22

PETROLEUM OPERATIONS

Critical Tasks: 01-5103.00-0003
01-5103.00-0004
01-5103.30-2103
03-5103.00-0076
03-5103.00-0078
03-5103.00-0085
03-5103.00-0089
03-5103.00-0091
03-5103.00-0096

OVERVIEW

LESSON DESCRIPTION:

In this lesson you will learn about basic petroleum definitions, petroleum management organizations, characteristics of petroleum products, categories of petroleum products and procedures used in petroleum related calculations.

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify basic petroleum definitions, petroleum management organizations, characteristics of petroleum products, categories of petroleum products and procedures used in petroleum related calculations.

CONDITIONS: Given the corresponding lesson plan and sited references.

STANDARDS: In accordance with FM 10-67, FM 10-67-1, and FM 10-67-2 with at least 70 percent accuracy.

REFERENCES: FM 10-67, FM 10-67-1, and FM 10-67-2.

1. Bulk Petroleum.

Bulk petroleum is the only commodity that:

a. Requires an exception to MILSTRIP in view of its peculiarities.

b. Is handled and stored in special single-purpose equipment and facilities such as: tankers, pipelines, tank cars, tank trucks, trailers, storage tanks, dispensing equipment, dock and discharge facilities.

c. Is subject to serious contamination which cannot be detected without the use of specialized equipment.

d. Provides an authorized loss allowance by regulation due to evaporation.

e. Requires special handling considerations due to fire and safety hazards.

f. Exceeds 60 percent of the gross tonnage of supplies required in a theater of operations.

2. Petroleum Definitions.

a. POL. Included are petroleum fuels, lubricants, hydraulic and insulating oils, temporary protectives, liquid and compressed gasses, chemical products, liquid coolants, deicing and antifreeze compounds, together with components and additives of such products.

b. Bulk Petroleum. Those bulk petroleum (fuels and lubricants) which are normally transported by pipeline, rail tank car, tank truck, barge, or tanker and stored in tanks or containers having a fill capacity of more than 500 gallons.

c. Packaged Fuels. Those bulk petroleum fuels which, because of operational necessity, are packaged and supplied in containers of 500 gallon capacity or less.

d. Packaged Petroleum Products. Those petroleum products other than fuels (generally lubricants, greases and specialty items) that are stored, transported, and issued in containers with a capacity of 55 gallons or less.

e. Barrel. A commonly used unit of measurement of bulk petroleum products. The equivalent of 42 U.S. gallons. The abbreviation is BBL.

f. Mike. A term used to denote measurement of bulk petroleum products in thousands of gallons or barrels (for example 10 mike barrels = 10,000 barrels). The abbreviation is M.

g. Flash Point. The temperature at which a product first gives off sufficient flammable vapor to ignite when a heat source is applied.

3. Petroleum Organizations.

a. Defense Logistics Agency. The agency at the Department of Defense level charged with providing the most effective and economical support of common supplies and services to military departments and other designated Department of Defense components. DLA has overall responsibility for the management of petroleum.

b. Defense Energy Supply Center.

(1) DLA activity responsible for the integrated material management of wholesale bulk petroleum products until their delivery to the point of sale. This responsibility includes contract administration in overseas areas.

(2) Provides management for all services.

c. US Army Petroleum Center.

(1) An activity, under the Army Material Command, with responsibility for the management of bulk petroleum products.

(2) Provides bulk petroleum management and assistance for the Army.

d. Navy Petroleum Office An activity with responsibility for the management of bulk petroleum and assistance for the Navy.

e. Air Force Petroleum Management.

(1) A major command function that has been decentralized. Each major command submits petroleum requirements directly to DESC.

(2) San Antonio Air Logistics Center provides technical assistance on petroleum-related matters.

4. Petroleum Characteristics.

a. Petroleum products float:

(1) Lighter than water.

(2) Water sinks to the bottom of storage container.

b. Petroleum fuels breathe:

(1) Expands as temperature increases. Causes loss of light ends.

(2) Contracts water through condensation.

(3) Petroleum is a mixture of hydrogen and carbon atoms with traces of other elements such as sulfur, nitrogen, oxygen, and helium.

(4) The petroleum products that the military uses for power generation are selected for specific characteristics depending on the type of power plant for which the fuel is going to be used.

c. There are fur types of engines that the military uses for power generation:

- Gasoline engine.
- Diesel engine.
- Turbine engine.

- Boiler.

(1) Gasoline engine.

(a) A gasoline engine produces power through what is essentially a controlled explosion.

(b) A mixture of fuel and air is injected into a chamber (piston cylinder), compressed by the piston, and ignited by a spark plug.

(c) The raising and lowering of the piston is what generates power to drive an axle.

(d) Gasoline engines require a fuel with a lower flash point than fuels used in diesel engines to ensure that e fuel will ignite when the spark is applied.

(2) Diesel engine:

(a) The diesel engine uses the same theory of controlled explosions, pistons, and cylinder to produce power. The major difference in the process is the source of ignition.

(b) In a diesel engine, air is compressed by the piston. As the pressure in the cylinder increases, the air temperature increases. The diesel fuel is then injected into the piston cylinder as a fine mist. The temperature of the air is sufficient to ignite the fuel and drive the piston downward.

(c) One of the most important properties of a diesel fuel is that it be capable of autoignition.

(3) Turbine engine:

(a) Air is compressed by a series of blades and routed to a combustion chamber.

(b) Fuel is injected into the combustion chamber and is ignited by an external source.

(c) Once the turbine is started, combustion is a continuous process, with the combustion keeping the compressors tuning and producing power.

(d) Theoretically, any type of fuel can be used for combustion, but once the engine is designed, a specific type of fuel must be used.

(4) Boilers:

(a) Boilers use burner fuel to create heat and transfer that heat to water in the form of steam.

(b) The steam transfers energy to an engine by tuning axles or shafts, creating power.

(c) One of the most important properties of a burner fuel is that it does not leave any sediment during combustion. Any sediment will tend to clog steam lines and inhibit power production.

5. Categories of Petroleum Products.

a. Automotive fuels.

(1) MOGAS. Motor gasolines are fuels used in reciprocating gasoline engines. They are characterized by having an extremely low flash point, which means that they are highly flammable. MOGAS is simply the same gasoline that you put in your own automobiles. Automotive gasolines are procured under Federal Specification VV-G-1690.

(2) Diesel fuels. Diesel fuel is a kerosene based fuel and is used specifically for diesel and turbine engines. Diesel engines differ from reciprocating engines in the ignition source. Where gasoline engines rely on a spark plug to ignite the fuel, diesel engines use the heat of compressed air to cause combustion. Therefore, diesel fuels have a much higher flash point than automotive gasolines.

(a) Diesel fuel used on board ships can be used in a boiler engine or turbine engine. Diesel Fuel Marine is procured under specification MIL-F-16884. It is used aboard ships at temperatures greater than 10 degrees Fahrenheit.

(b) Diesel fuel for automotive use is now regulated for sulfur content by the EPA. Low sulfur diesel, (less than 0.05 percent) is now the standard diesel fuel for automotive use in the U.S. Military until the JP-8 conversion is complete. is procured under specification VV-F-800.

(c) Diesel Fuel Arctic is used where mean ambient temperature is less than -25 degrees Fahrenheit. It is used in high speed automotive engines and pot type burner space heaters.

(d) Diesel Fuel 1 (DF1) (Winter) is used for temperatures down to -25 degrees Fahrenheit. It is used in medium speed stationary engines.

(e) Diesel Fuel (DF2) (Regular) is used in temperatures above 0 degrees Fahrenheit, high speed automotive engines, and medium speed applications.

(3) JP-8:

(a) As a ground fuel, JP-8 bums hotter and cleaner than diesel in automotive engines.

(b) The conversion process is complete in Europe.

b. Aviation fuels.

(1) JP-4.

- Primarily used by Army for aviation turbine engines.
- Being replaced by JP-8.
- Highly volatile - flash point less than -10 degrees F.
- Straight run gasoline.
- Low vapor pressure: 2-3 psi.
- Clear to straw yellow in color.

(2) JP-5.

- Primarily used by the Navy because of high temperatures board naval vessels.
- Less volatile than JP-4. Flash point is 140 degrees F.
- Clear to straw yellow in color.
- Zero vapor pressure.
- Heavy cut of kerosene.

(3) JP-8 (also a kerosene based fuel).

- Less volatile than JP-4. Flash point is 100 degrees F.
- Zero vapor pressure.
- Color -- water white.
- Cold weather starts.

(4) Aviation Gasoline. AVGAS is used in reciprocating aviation engines (propeller-driven).

(a) At one time several different types. Now moving toward AVGAS 100/130.

(b) First number of rating is the knock number under lean conditions and the second is the knock number under rich conditions.

(c) Color - light purple.

c. Burner fuels.

(1) Navy Special Fuel Oil.

(2) Fuel Oil, Burner, Federal Spec VV-F-8 15.

d. Lubricants.

(1) Lubricating Oil. SAE Motor Oil standardization classifies motor oils according to their viscosity.

- Either petroleum type oils or synthetic type oils.
- Single viscosity and multi-viscosity oils.
- Winter grade viscosity - - W.

(2) Greases.

- Manufactured by compounding petroleum and synthetic oils with metallic soaps.
- Used in places where lubricating oil will not remain because of "run off" tendency.

e. Specialty Items.

- Solvents.
- Hydraulic fluids.
- Cutting and insulating oils.
- Anti-freeze fluids.
- Coolant.
- Protective compounds.

6. Petroleum-Related Calculations.

a. Specific Gravity.

(1) The ratio of the weight of 1 gallon of fuel to the weight of 1 gallon of distilled water at a temperature of 60 degrees Fahrenheit.

(2) The weight of 1 gallon of water is 8.33 pounds.

(3) The specific gravity of water is 1.0000 $\frac{8.33}{8.33} = \frac{1.0000}{}$

(4) The weight of 1 gallon of MOGAS is 6.20 pounds.

The specific gravity of MOGAS is $\frac{6.20}{8.33} = \frac{0.7443}{}$

b. Definition of API Gravity:

(1) An arbitrary scale developed by the American Petroleum Institute to measure the specific gravity of liquid petroleum products at a temperature of 60°F. The scale was developed to eliminate the problem of working with decimals associated with specific gravity.

(2) Water has an API of 10.0°. As the API goes up, its corresponding specific gravity goes down (an inverse relationship).

(3) Correction of API to 60 degrees Fahrenheit.

(a) Round tenths place of the API reading as follows:

- .1, .2 down to .0
- .3,.4,.6,.7 to .5
- .8,.9 up to next .0

(b) Turn trough ASTM Table 5B until you find observed API degrees across the top of the chart and the observed temperature down the left side. Where the two intersect on the chart is the corrected API.

(c) Converting API and Specific Gravity.

(1) To convert API to SG: $\frac{141.5}{°API + 131.5}$

(2) To convert SG to API: $\frac{141.5}{° API} - 131.5$

Problem: Convert 56.0 API to SG

Solution: $\frac{141.5}{56.0 + 131.5} = \frac{141.5}{187.5} = .7546$

Problem: Convert .7443 SG to API

Solution: $\frac{(141.5)}{(.7443)} - 131.5 = 190.1 - 131.5 =$ **58.6 API**

d. Weight Problems.

(1) Petroleum handlers are required to convert pounds of fuel to gallons when involved in aircraft refuel missions.

(2) Using the specific gravity of the fuel and the weight of water, we can convert pounds to gallons and vice versa.

(3) To determine the weight of 1 gallon of fuel, multiply the weight of 1 gallon of water (8.33 lb.) and the specific gravity of fuel.

(4) To convert pounds to gallons:

(a) Determine the weight of 1 gallon of fuel.

(b) Divide the weight of the fuel by the weight of 1 gallon of fuel.

(5) To convert pounds to gallons:

(a) Determine the weight of 1 gallon of fuel.

(b) Multiply the gallons of fuel by the weight of 1 gallon of fuel.

Example: Convert 325 pounds of JP-4 to gallons (47.9 API at 60 degrees F)

Solution:

Step 1. Determine SG at 60 degrees F

$$SG = \frac{141.5}{47.9 + 131.5} = \frac{141.5}{179.4} = \mathbf{0.7887}$$

Step 2. Determine weight of 1 gallon of fuel:

(8.33 lb) X .7887 = **6.57 lb**

Step 3. Determine the number of gallons:

325 + 6.57 = **50 gallons**

Example: Convert 100 gal JP-8 (SG = 0.8063) to pounds.

Step 1. Determine weight of 1 gallon of JP-8

8.33 b x 0.80631 = **6.72 lb per gal**

Step 2. Determine weight of 100 gal of JP-8

100 gal JP-8 x 6.72 lb per gal = **672 pounds**

LESSON 22

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. What DOD organization manages bulk petroleum?

   A. DFM
   B. DESC
   C. DER
   D. DLA

2. The specific gravity of a fuel is the ratio between the weight of the fuel and the weight of what?

   A. Sand
   B. Petroleum
   C. Oxygen
   D. Distilled water

LESSON 22

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1.	D. DLA, (page 22-2, para. 3a. and page 22-3, para. 3b.(1))
2.	D. Water. (page 22-7, para. 6.a.)

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LESSON 23

PETROLEUM ORGANIZATIONS AND MISSIONS

Critical Task: 03-5103.00-0087
03-5103.00-0088
03-5103.00-0089
03-5103.00-0093
03-5103.00-0096
03-5103.00-0135

OVERVIEW

LESSON DESCRIPTION:

Understand the organization for National Security and the organizations and missions of the Joint Chiefs of Staff, unified commands, and Department of Defense activities.

TERMINAL LEARNING OBJECTIVE:

ACTION: Understand the organization for national security; organization and missions of the Joint Chiefs of Staff, unified commands, Department of Defense activities; specific wartime responsibilities of DOD organizations; and the organization of each branch of service for petroleum supply. Understand the responsibilities of the Department of Defense, military services, unified commands, Defense Logistics Agency, and Defense fuel regions for DOD bulk petroleum management.

CONDITION: IAW this lesson plan and the listed references.

STANDARD: With at least 70 percent accuracy

REFERENCES: AFSC Pub 1, DOD 4140.25-M, FM 10-67-1, FMFM 4-18, FM 5-482, FM 54-30, FM 63-2, FM 63-3, NAVSHIPS PMS 390, CLF/CPFINST 4026.1, AFP 144-3, AFI 23-201, AFI 38-101 and AFM 67-1.

INTRODUCTION

As petroleum officers in a joint service environment, it is critically important that everyone understand the organizations and missions of each service for petroleum supply in a theater of operations.

1. Organization for National Security.

    a. National Security.

(1) The National Command Authority consists of the President of the United States and the Secretary of Defense or their duly appointed alternates or deputies. Both movement of troops and execution of military action must be directed by the NCA.

(2) The National Security Council was established by the National Security Act of 1947 and provides a forum for discussing and considering national security issues that require Presidential decision. The members of the NSC are the President, the Secretary of State, and the Secretary of Defense. The Chairman of the Joint Chiefs of Staff and the Director of Central Intelligence are advisors to the NSC.

b. Department of Defense.

(1) Secretary of Defense. Since 1986, the Secretary of Defense clearly has undisputed control of the department and the position in the chain of command is very clear.

(2) Joint Chiefs of Staff.

(a) The OJCS consists of the Chairman, the Chief of Staff of the Army, the Chief of Naval Operations, the Chief of Staff of the Air Force, and the Commandant of the Marine Corps. The chairman presides over meetings and sets the agenda for the JCS. Duties as members of the JCS take precedence over duties as chiefs of their respective services.

(b) The Joint Chiefs of Staff have no executive authority to command combatant forces. Combat forces are assigned to a unified or specified command and those commanders exercise executive authority.

(c) The functions of the Chairman, Joint Chiefs of Staff are:

1 Furnish strategic direction of the Armed Forces

2 Prepare strategic plans, prepare joint logistic and mobility plans, and perform net assessments of the capabilities of the Armed Forces.

3 Provide for preparation and review of contingency plans and advise on critical deficiencies and strengths in force capabilities.

4 Advise on the priorities of requirements, advise on program recommendations and budget proposals, and assess military requirements for defense acquisition programs.

5 Develop doctrine for joint employment and formulate policies for coordinating military education and training.

6 Other functions of the Chief, OJCS are:

a Transmit communications between the NCA and combatant commands

b Review plans and programs for adequacy and feasibility

(d) The functions of the Military Service Chiefs are to offer advice to the President, NSC, and Secretary of Defense. As chiefs of their respective services, each is responsible to the service secretary for the management of the service. The service chiefs serve for four years. By custom, the vice-chiefs of the service are delegated authority to act for their chiefs in most matters having to do with the day-to-day operation of the services.

(e) The Office of the Joint Chief of Staff has a Joint Staff to support them. The National Security Act of 1986 restricted the size of that staff to 1,627 military and civilian personnel. This allocation is divided equally between the Army, Navy, and Air Force. The Marine Corps traditionally takes approximately 20 percent of the Navy's allocation. The Chairman, OJCS appoints a Director, Joint Staff to assist in managing the staff.

1 The Joint Staff assists the Chairman with:

a Unified strategic direction of the combatant forces

b Unified operation of the combatant commands

c Integration into an efficient team of land, naval and air forces.

2 The staff is organized into 10 directorates:

- Manpower and Personnel Directorate (J-1)
- Operations Directorate (J-3)
- Logistics Directorate (J-4)
- Strategic Plans and Policy Directorate (J-5)
- Command, Control and Communications Directorate (J-6)
- Operational Plans and Interoperability Directorate (J-7)
- Force Structure, Resource, and Assessment Directorate (J-8)
- Directorate of Information and Resource Management
- Advisor for Mapping, Charting, and Geodesy Support
- Office of the Inspector General

In addition to these directorates, the Directorate for JCS Support of the Defense Intelligence Agency supplies the Joint Staff and the Chairman with intelligence support, but is not a member of the Joint Staff.

(f) Organizations reporting to the Secretary of Defense through the Chairman, JCS.

Unified Commands are commands that have broad, continuing missions and are composed of forces from two or more military departments. Each of the unified commands is directly responsible to the Secretary of Defense and the NCA. The OJCS is in the communications chain of command, which means that communications from the NCA to the unified commands pass through the OJCS. There are currently nine unified commands. Five of them have regional responsibilities and four have functional responsibilities.

1 Regional unified commands:

- U.S. Atlantic Command, located in Norfolk, Virginia
- U.S. European Command, located in Stuttgart, Germany.
- U.S. Southern Command, located in Miami, Florida.
- U.S. Central Command, located at McDill AFB, Florida.
- U.S. Pacific Command, located at Camp Smith, Hawaii.

2 Functional commands

- U.S. Special Operations Command.
- U.S. Transportation Command.
- U.S. Space Command.
- U.S. Strategic Command.

(3) Unified Command Joint Staffs. The staffs at each of the unified commands are organized essentially the same as the Joint Staff that support the JCS. A typical joint staff is as follows:

(a) Manpower and Personnel Division (J-1). Manages personnel, develops personnel policies, administers military and civilian personnel within the command, and administers prisoners of war.

(b) Intelligence Division (J-2). Ensures that the joint command has sound intelligence on the area of operations and the location, activities and capabilities of threat forces. Activities may include HUMINT, and counterintelligence, target identification and selection, and electronic gathering and analysis.

(c) Operations Division (J-3). Directs and controls current operations. The division is responsible for initial planning and integration and coordination of joint operations. Responsibilities of the division may include the conduct of special operations, including PSYOP and special warfare, joint training and coordination of joint exercises.

(d) Logistics Division (J-4). Develops logistics plans and coordinates and supervises supply, maintenance, repair, evacuation, transportation, construction, and related logistics activities. The primary thrust of joint logistics operations is to coordinate service programs and integrate then with the joint commander's concept of support.

1 The J-4 Division has numerous sections for each functional area of logistics.

2 The Joint Petroleum Office is part of the unified command J-4 Division and is responsible for advising the commander on all petroleum related plans and policies.

3 In overseas areas, the JPO is responsible for consolidating all of the services petroleum requirements and preparing the "slate."

(e) Plans and Policies Division (J-5). Develops long-range plans. The division prepares campaign, concept and operations plans, and the associated Commanders Estimate of the Situation. If the command has no J-5 division, these responsibilities fall to the J-3.

(f) Command, Control and Communications Division (J-6). Develops command responsibilities for communications and frequency control, tactical communications planning and execution, and management and development of electronics and automatic information systems.

(g) Security Assistance Division. Coordinates the support of military and economic aid to host nations in the command's region of responsibility. This function is vitally important to U.S. foreign policy. This division is found in the J-4 if it is not a separate organization.

(h) Interoperability Division. If this is a separate division from the J-3, it is responsible joint planning, plans evaluation and analysis, development of joint doctrine, coordinating joint education and training, and the conduct of joint training exercises.

(i) Force Structure, Resources and Assessment Division. Plans and programs the budgeting system and coordinating budget activities between the services in the command.

c. Department of Defense Agencies. DOD Agencies report to the Secretary of Defense through the Chairman, Joint Chiefs of Staff

- Defense Intelligence Agency
- Defense Logistics Agency
- Defense Map ping Agency
- Defense Nuclear Agency
- Military Communications-Electronics Board

2. Department of Defense.

a. DOD Policy.

(1) Goal. DOD bulk fuel programs shall support the DOD peacetime and wartime missions and permit successful deployment and employment of forces at minimum cost.

(2) DOD components will minimize the number of bulk petroleum products stocked and distributed, plan to use fuels readily available worldwide, and minimize the military unique characteristics of DOD fuels.

(3) DOD components shall minimize inventories consistent with the peacetime and contingency needs of U.S. military forces worldwide. Inventories will be characterized as POS or BPWRS.

(a) POS is the amount of fuel required to sustain peacetime operations in support of military demands.

(b) BPWRS is limited to a stockage level for mobility requirements, strategic lift, strategic air operations, civil defense requirements (when approved by the Under Secretary of Defense, Logistics) and logistics operations in support of strategic operations such as load out of ships and aircraft in-flight refueling operations.

b. Responsibilities of DOD.

(1) Under Secretary of Defense for Acquisition and Technology include:

(a) Establish policies, grant policy waivers, approve changes in responsibilities for management of bulk petroleum stocks and facilities, and provide procedural guidance to the DOD components and ensure their effective implementation.

(b) Act as the DOD claimant to the Department of Energy for required petroleum products.

(c) Review contingency BPWRS levels recommended by the Chairman, JCS and establish policy guidance.

(2) Deputy Under Secretary of Defense (Logistics). Serves as the DOD central administrator for energy management and Integrated Material Management oversight responsibility for petroleum products.

(3) Department of Defense Comptroller. Coordinates with the USD (A&T) to establish financial policies and guidance for the management of bulk petroleum products.

c. Responsibilities of Military Services.

(1) The Secretaries of the Military Services will:

(a) Provide for the operation of petroleum facilities; control the issue, receipt and management of stocks at operating locations; plan, program, fund, and perform operator/organizational maintenance of facilities on their installations; and design, fund, and construct petroleum facilities used solely in support of the Military Services' petroleum management missions.

(b) Implement fuel standardization policies as outlined under DOD policy.

(c) Assist the DLA in the selection and assignment of priority to MILCON projects identified for the DLA MILCON program; and provide base-level technical support for DLA-funded maintenance, repair, and construction at military base-level petroleum facilities.

(d) Manage military-unique or theater-assigned bulk petroleum transportation assets.

(e) Compute wartime demands based on unified command operations plans, wartime fuel consumption rates, and war reserve requirements by location; and establish wartime demand profile.

(f) Provide data on all BPWRS to DLA and unified commanders, IAW procedures outlined in DOD Manual 4140.25M.

(g) DOD components shall make maximum use of commercial and host nation sources of supply to meet peacetime and wartime requirements.

(2) The Secretary of the Army shall provide management of overland petroleum support, to include inland waterways to U.S. land-based forces of all DOD components.

(a) To ensure wartime support, Army tactical storage shall supplement existing fixed facilities to include host nation assets and commercial storage.

(b) The Army is responsible for inland distribution planning during wartime.

(3) The Secretary of the Navy shall provide seaward and over-water bulk petroleum shipments to the high-water mark for U.S. sea and land-based forces of all DOD components.

(4) The Secretary of the Air Force shall provide distribution of bulk petroleum products by air. This method of movement is reserved for situations demanding immediate support at remote locations.

d. Responsibilities of the Chairman, Joint Chiefs of Staff are as follows:

(1) Provide an annual report on HNS agreements which support fuel-requirements, distribution shortfalls, and the state of such negotiations to USD (A&T).

(2) Recommend contingency war reserve stock levels to the USD (A&T).

(3) Prescribe procedures for reporting DOD component petroleum planning data to alliance or other host nation authorities involved in combined defense planning.

(4) Recommend changes to responsibilities of the Commander of Unified Commands

e. Responsibilities of Unified Commands.

(1) Plan, manage, and coordinate the receipt, storage, and distribution of petroleum products in theater in coordination with the Director, DLA.

(2) Plan to convert from primary to alternate fuels as needed.

(3) Coordinate and prioritize DLA MILCON projects and qualified maintenance and repair projects for petroleum facilities in theater; and coordinate DESC tankage leasing plans and related activities.

(4) Ensure fuels requirements, operations, and constraints are published/addressed in fuels annex of OPLANS.

(5) Negotiate in conjunction with DLA formal HNS and coordinate the development and release of combined and/or alliance petroleum planning data.

(6) Release or reallocate BPWRS in an emergency or war.

(7) Direct DLA elements within their geographic area to ensure effective operations of storage and distribution facilities following approval from DLA or CJCS. Approval is required for the coordination of:

(a) Movement or evacuation of personnel.

(b) Stockage and distribution of petroleum products.

(c) Acquisition or construction, maintenance, operation, and disposition of petroleum facilities and associated services.

(8) Provide physical security and administrative and logistical support for DLA elements as specified in interservice support agreements.

(9) Exercise administrative direction over DLA elements consistent with that which is exercised over other DOD components.

(10) Advise the Director, DLA of any recommended changes to or dissatisfactions with the type, adequacy, and responsiveness of logistical support provided by DLA. Unresolved issues are referred to CJCS for resolution.

(11) Make maximum use of available tocks in adjacent theaters to support regional contingency requirements.

(12) Coordinate the quality surveillance program within the command.

(13) Establish SAPOs as necessary to provide in country or regional staff management functions.

(14) Direct tactical movement of fuel by means available to any DOD component in a theater of operations.

f. Responsibilities of the Defense Logistics Agency.

(1) Execute the IMM responsibility for bulk petroleum products. The responsibilities under IMM are:

(a) Plan, program, budget, and fund facility, maintenance, and repair, and construction of new permanent storage and associated distribution facilities.

(b) Design and execute maintenance, repair, and construction projects in coordination with the military services and unified commanders.

(c) Plan, program, budget, and fund for contract storage and associated services in support of the DLA bulk petroleum management mission.

(d) Negotiate and conclude international agreements, in conjunction with the CINCs, to provide bulk petroleum products, additives, laboratory testing, facilities; pipelines, and related services.

(2) Develop contingency support plans in concert with unified commanders to acquire the necessary petroleum products, storage, and/or associated services in support of military needs.

(3) Provide technical support involving military specifications when operational needs require the use of other-than-specified fuels. The support will be coordinated with the military technical authorities.

(4) Allocate resources for BPWRS requirements, compute the POS requirements, and develop the inventory management plan by location.

(5) Develop the funding for the annual quantity of BPWRS requested for any fiscal year.

(6) Continuously evaluate the petroleum market and advise the USD (A&T), CJCS and military services of considerations critical to peacetime and wartime operations and planning.

(7) Establish and maintain DFRs and DFOs as necessary.

g. Defense Fuel Regions and Defense Fuel Offices. DFRs and DFOs provide regional logistical support for Defense Fuel Supply Points worldwide. Defense fuel offices are subregional offices of overseas DFRs.

(1) There are four CONUS DFRs and three overseas DFRs:

(a) DFR Northeast is located at MacGuire Air Force Base, New Jersey.

(b) DFR Central is located in St. Louis, Missouri.

(c) DFR South is located in Houston, Texas. DFR South is also responsible for the Caribbean, Central America, and South America.

(d) DFR West is located in San Pedro, California.

(e) DFR Europe is located in Pirmasens, Federal Republic of Germany. DFR Europe is responsible for Continental Europe, United Kingdom, Mediterranean Sea, Iceland, Scandinavia, Azores, Turkey, and Africa (less the countries assigned to DFR Middle East). DFR Europe has three Defense Fuel Offices: DFO-Italy, DFO-NATO, and DFO-Turkey.

(f) DFR Middle East is located in Juffair, Bahrain and is responsible for Afghanistan, Pakistan, Jordan, Iran, Iraq, Saudi Arabia, Oman, United Arab Emirates, Bahrain, Kuwait, Qatar, Yemen, Djibouti, Egypt, Ethiopia, Kenya, Somalia, and Sudan.

(g) DFR Pacific is located at Camp H. M. Smith, Hawaii and is responsible for Hawaii, Marianas, Philippines, Korea, Japan, Ryuku Island, Taiwan, Australia, New Zealand, Thailand, Malaya, East Indies, Burma, Sri Lanka, Indian Ocean, South Pacific, Alaska, and the Aleutian Islands. DFR Pacific has two Defense Fuel Offices; DFO Alaska located at Elmendorf Air Force Base and DFO Korea located in Taegu, Korea.

(2) DFRs responsibilities are to:

(a) Order fuel based on Distribution Plan Authorizations.

(b) Transport fuel by the most economic means possible.

(c) Monitor DFSP inventory levels reported in the Inventory Management Plan.

(d) Monitor and coordinate receipts and shipments at GOCO/COCO DFSPs and act as contracting officer.

(e) Review accountable documents for allowable losses at contractor-operated facilities.

(f) Develop quality surveillance programs for DLA-owned products.

1 Submit proposed stock rotation plans to DESC operations for dormant socks.

2 Notify DESC operations of quality problems that may affect supply operations.

(g) Ensure overseas DFRs perform the same functions as CONUS DFRs. Additional responsibilities of overseas DFRs are to:

1 Coordinate distribution plans with CINC JPOs.

2 Manage U.S. interests in overseas pipelines and negotiate with host nations.

3 Serve as the central point of contact for DFAMS.

3. Specific War, Contingency, and Emergency Considerations.

a. General DOD policy that applies during peacetime for bulk petroleum should apply whenever possible during periods of international tension and limited or general war.

b. War reserve stocks will not be reconstituted under general war conditions. Wartime operating stock levels after D-Day will be maintained at the minimum level needed for planned operational commitments (resupply quantity plus safety level).

c. Petroleum stocks held by military services are subject to reallocation by the JCS or Unified Command CINCs.

d. DOE responsibilities include:

(1) Prepare emergency plans and develop preparedness programs for petroleum products, natural gas, coal, and electric power.

(2) Assist, coordinate and direct the energy industries during national emergencies to assure that domestic and foreign energy supplies can meet the military and civil requirements of the nation and its allies.

e. Deputy under Secretary of Defense (Logistics) responsibilities include:

(1) Establish and provide policy guidance on DOD bulk petroleum logistics.

(2) Resolve any conflicts on industry allocation of bulk petroleum in coordination with DOE, FEMA, and other Federal agencies.

f. Chairman, JCS is primarily responsible for allocating bulk petroleum stocks to military services when bulk petroleum requirements exceed DOD stocks.

g. Unified Command JPOs will:

(1) Submit the POLCAP and the REPOL as required.

(a) POLCAP gives the JCS an overview of the status of bulk petroleum support capabilities for contingency requirements in a specific theater or subtheater.

(b) REPOL gives the JCS an overview of damage and capabilities of bulk petroleum facilities, storage, and distribution systems

(2) Allocate emergency fuel requirements for the period D+60 to D+180.

(3) Allocate bulk petroleum stocks to component commands when stockage levels do not meet requirements.

i. Component Commanders in the Unified Command will slate requirements for bulk petroleum from D+60 to D+180 in 30-day increments with the JPO.

j. Each of the Military Services will:

(1) Compute BPWRS requirements IAW DOD 4140.25M, Chapter 11.

(2) Support JPOs with POLCAP and REPOL data for each service.

(3) Coordinate release of BPWRS with DESC and JPOs.

(4) Operate and maintain DFSPs and maintain POS and BPWRS levels at those DFSPs under their control.

k. DLA/DESC will:

(1) Consolidate bulk petroleum requirements from D+60 to D+180 NLT D+35. Any requirements for that time period that cannot be filled by normal contracting will be submitted to the DUSD (L) for guidance.

(2) Develop plans and procedures for contingency operations.

(3) Develop and maintain emergency/alternative plans for GOCO and COCO DFSPs under DESC contracts and provide guidance to DFRs.

4. Terms and Definitions.

a. Terms and Definitions

(1) Theater - Geographical area in which a unified command (Army, Navy Air Force and Marines) conducts military operations.

(2) Communications Zone (COMMZ) - Geographic area behind the corps rear boundary.

(3) Combat Zone - Geographical area from the Forward Line of Troops (FLOT) to the Corps rear boundary.

(4) Direct Support - Supply support that is provided to the using unit. Direct Support Units (DSU) provide supplies and services to customer units.

(5) General Support - Supply support provided to Direct Support Units and other General Support Units.

(6) Divisional - Units assigned or attached to a division.

(7) Nondivisional - Units not assigned or attached to a division.

b. Organization of the Army in the Field.

(1) Company - First major unit with command responsibility.

(2) Battalion - Can command and control up to five companies.

(3) Brigade - A brigade can consist of up to five infantry or armored battalions.

(4) Division - Largest self-supporting tactical unit in the Army. A division is normally composed of three maneuver brigades, a field artillery brigade, an aviation brigade, and a support command.

(5) Corps - Largest tactical unit in the Army. A corps is generally composed of two or more divisions and associated support elements.

(6) Army - Responsible for all planning, command and control of all Army Forces in a theater of operations. A Theater Army is made-up of two or more corps and associated support elements.

4. Army Organization for Petroleum Management.

a. Army Energy Office. This office provides guidance that is directive in nature to the Army. It issues directives on force structure and responsibilities for Army activities and organizations. - It provides interface between the Army and the Office of the Joint Chiefs of Staff for petroleum-related issues.

b. Army Petroleum Center. An agency of the Army Materiel Command located in Harrisonburg, Pennsylvania. It acts as the Army's manager of bulk petroleum, advises on petroleum-related issues, and conducts periodic inspections. It also reviews Army requirements worldwide and provides information to DESC.

c. Project Manager. Petroleum and Water Logistics (PM-PWL).

(1) Serves as materiel developer for petroleum and water equipment, to include: receipt, storage, distribution, treatment, and surveillance of operational stocks.

(2) Act as the executive agent for water and petroleum issues for the Department of the Army.

(3) Support military and civilian contingency operations a directed.

(4) Provide centralized life cycle management of petroleum and water logistics equipment.

- 75 petroleum systems
- 22 water systems
- 2 operational projects

(5) Support evolving doctrinal concepts and make recommendations on subjects such as:

- Force Structure
- Operational Plans for unified commands
- Army Mobility Strategic Plan
- Force Provider

d. Petroleum Units.

(1) Theater Army Commander is responsible for all ARFOR in the theater.

(a) Inland distribution of bulk petroleum throughout the theater is an ARFOR responsibility.

(b) The Theater Army is organized for bulk petroleum support as follows:

- Petroleum Group
- TAACOM
- COSCOM
- DISCOM

(2) Petroleum Group duties include.

(a) Responsible for the detailed planning of the petroleum supply organization and distribution.

(b) Assigned directly to Theater Army.

(c) Provides command and control for the petroleum pipeline and terminal operating battalions.

(d) Major subordinate unit for the Petroleum Group is the Petroleum Terminal and Pipeline Operating Battalion.

(3) Petroleum Terminal and Pipeline Operating Battalion.

(a) Supervises, operates, and maintains petroleum distribution facilities within the theater to include:

- Port(s) of entry.
- Pipelines.
- Tactical Petroleum Terminals.

(b) The battalion's major subordinate unit is the Petroleum Terminal and Pipeline Operating Company.

(c) Capabilities of the battalion are:

- Operates central scheduling and shipping office.
- Coordinates movement of fuel.
- Maintains prescribed reserves.
- Supervises quality surveillance.
- Commands and controls up to five companies and 450 miles of pipeline.

(4) Petroleum Terminal and Pipeline Operating Company.

(a) Operates and maintains multi-product pipeline and terminal facilities for the storage and distribution of bulk fuels.

(b) Capabilities and equipment.

1 Operates up to 90 miles of pipeline.

2 Establishes and operates the TPT.

3 Able of storing 4.08 million gallons of fuel in eighteen - 210,000 - gallon and six- 50,000 - gallon collapsible tanks.

4 Each TPT consists of three fuel modules; each fuel module consists of three tank farm assemblies; each tank farm assembly consists of two - 210,000 - gallon tanks.

5 Theater Army Area Command.

a TAACOM provides combat service support to all units in or passing through the COMMZ.

b Subordinate unit of TAACOM for POL is the QM Supply Company (DS).

6 QM Supply Company (DS)

a Provides DS supply support to customer units.

b Capabilities and Equipment:

- 2 -- Fuel System Supply Points.
- 2 -- Tank and pump units.
- 9 -- 5,000 - gallon tankers.

c Receives fuel from the petroleum Supply Company.

d Found at theater level in a supply and service battalion in the TAACOM and in corps support battalions in the COSCOM.

7 Corps Support Command.

a Provides combat service support to Army nondivisional units in the corps area.

b Provides GS to the divisions of the corps.

c Major subordinate unit of the COSCOM for POL is the Corps Support Group.

d In an undeveloped theater, the Petroleum Group may be a subordinate unit of the COSCOM.

8 Petroleum Supply Battalion.

a Provides command and control for GS class III support to corps and divisional units.

b Can provide command and control of up to five companies.

c Major subordinate units for POL are:

- Petroleum Supply Company
- Medium Truck Company (POL)

d Can be found in both the COMMZ and the corps area.

9 Petroleum Supply Company.

a Provides GS petroleum support (receive, store, issue, and transfer) to DS petroleum units and high volume user throughout the theater.

b Receives fuel from petroleum terminal and operating battalion.

c Capabilities:

- Installs/Operates/Retrieves 15 miles of assault hoseline.
- Maintains reserve stockage.
- Stores up to 2.64 million gallons of fuel in 10,000, 20,000 and 50,000 gallon collapsible fabric tanks.
- Operates up to 12 Fuel System Supply Points and 6 Forward Area Refueling Equipment Systems.

d Can provide limited direct support for class III.

e Found at both the theater and corps level.

10 Medium Truck Company (POL).

a Provides transportation for bulk petroleum between GS, DS, and using units.

b Capabilities and equipment:

- 60 -- 5,000 - gallon tankers.
- Able to line haul 450,000 .gallons per day based on 75 percent availability of equipment and two trips per day (90 miles) or local hauling 900,000 gallons per day (20 miles) four trips per day.

c Can be found at the theater or corps level in the petroleum group, the TAACOM or the COSCOM.

11 Division Support Command.

a Provides combat service support to all organic and attached units of the division.

b Major subordinate units of the DISCOM for POL are:

- Supply and Service Company, Main Support Battalion.
- Supply Company, Forward Support Battalion.
- Headquarters and Supply Company, Aviation Support Battalion.

12 Supply and Service Company, MSB.

a Provides DS combat service support to units in the division support area.

b Capabilities and equipment:

- (1) 2 -- Fuel System Supply Points.
- (2) 2 - tank and pump units.
- (3) 34 -- 5,000 - gallon tankers.
- Capable to line haul 250,000 gallons per day or local hauling 500,000 gallons per day.

c Provides class III support through retail operations and pushes fuel forward to the brigades as needed.

13 Supply Company, FSB.

a Provides class I, III, IV, V and VII to the units assigned or attached to the supported maneuver brigade.

b Capabilities and equipment:

- (1) 10 -- 5,000 - gallon tankers.
- (2) 2 -- Tank and pump units.

- Able to line haul 75,000 gallons per day or local haul 150,000 gallons per day.

c Issues fuel to the maneuver battalions either in the BSA via LOGPAC or sets up logistics release points in designated areas.

14 Headquarters and Supply Company, ASB.

a Provides same support to the Divisional Aviation Brigade and cavalry squadron that the Supply Company, FSB provides to the maneuver brigade, except there is no class V ATP.

b Class III platoon has a storage section, a FARP section, and a refueling section.

c Capabilities and equipment:

- 1 Airmobile laboratory.
- 2 Fuel System Supply Point.
- 12 -- HEMTT Tankers.
- 8 Advanced FARE systems.
- 3 -- 5,000 - gallon tankers.
- 3 HEMTT Tanker Aviation Refueling System.

d Class III support is provided by the Class II/V platoon and consists of

1 The platoon headquarters, which provides command and control for the platoon and is responsible for quality surveillance and inventory control.

2 The storage/issue section, which operates the FSSP to store and issue, bulk petroleum to the aviation brigade.

3 The FARPs resupply section, which provides class III support to the FARPs operated by the aviation brigade and the cavalry squadron.

4 The aircraft refueling section, which provides rear area refueling, support to the brigade's aircraft.

e. Fuel Flow in the Theater.

(1) Fuel enters the theater from DESC and is brought inland by the Petroleum and Terminal Operating Battalion.

(2) The Petroleum Supply Battalion receives fuel from the PTO Battalion for issue to direct support petroleum units. The Medium Truck Company (POL) is the primary means of transporting bulk fuel forward of the COMMZ.

(3) In the COMMZ and the corps area, the QM Supply Company (DS) issues fuel to using units.

(4) In the Division Support Area, the S&S Company issues fuel to the units in the DSA and the HSC of the ASB issues fuel to the Division Aviation Brigade and the Cavalry Squadron.

(5) In the Brigade Support Areas, the Supply Company of the supporting FSB issues fuel to the battalions of the maneuver brigades.

5. Organization of the Navy.

The Navy (assisted by the Military Sealift Command) delivers the majority of bulk fuel overseas to DOD forces in both peacetime and during combat operations. Knowing how they do so, as well as how other vital supplies reach the fleet, can provide Army officers with additional logistics knowledge which could well prove critical in a joint forces wartime scenario.

a. Navy Petroleum Organization Overview.

(1) SECNAV directs and guides the Navy as a component of DOD.

(2) CNO executes SECNAV taskings.

(3) NAVSUP develops and implements procurement and management of Navy Stock Fund items (repair parts, ADP equipment) including petroleum products.

b. Navy Petroleum Office Overview.

(1) Dual missions.

(a) Serves as Deputy Commander, NAVSUP for petroleum management purposes.

(b) Provides technical direction and assistance for petroleum management programs.

(2) Direction and assistance.

(a) Fuel quality.

(b) Facility construction and improvement.

(c) POL officer trainee programs.

(d) Fuel reclamation.

(e) Peacetime/war reserve POL requirements determination.

(f) Facility automation.

(3) Planning/Admin Division.

(a) Coordinates day-to-day administrative and financial business of NAVPETOFF.

(b) Responsible for once/year determination and promulgation of Navy bulk POL War Reserve requirement levels.

(c) Provides management oversight to Petroleum Officer trainee (intern) program.

(4) Requirements Division.

(a) Coordinates and verifies all Navy bulk fuel, into-plane, bunker, and overseas post, camp, and station supply requirements.

(b) Administers USN/foreign navy fuel exchange agreements.

(c) Coordinates all matters between DESC and field activities relating to DFAMS.

(5) Operations Division.

(a) Is the Navy commodity manager for packaged petroleum products.

(b) Provides management oversight to the Navy aircraft-refueling program at 27 CONUS locations.

(c) Provides technical assistance in the areas of fuel operations and quality control to all Navy activities.

(6) Facilities Division.

(a) Is the focal point for design review of POL-related projects at Navy defense fuel supply points worldwide.

(b) Provides management oversight in the execution of fuel facility automation and pollution control equipment installation.

(c) Provides engineering advice and assistance to field activities.

c. Fuel for the Fleet.

(1) FISCs arrange receipts and issues.

(2) Fuel terminals distribute fuel to tankers, barges, and trucks.

d. Fuel at the User Level.

(1) Ships at sea are assigned, under a Unified Command, to a Fleet Commander or Commander, Joint Task Group, depending on location or tasking. These commands have their own operations and logistics staff who:

(a) Project out fuel and provisions consumption.

(b) Review logistic asset availability-could include.

- Shore bunkering in Augusta Bay, Sicily.
- A Military Sealift Command ship.
- A Navy replenishment ship.
- Other friendly assets (NATO oilers).

(c) Revise and promulgate operational schedules, including both ships and forward logistic heads (for example, Hurghada, Egypt; Incurlik, Turkey).

(d) Rotate assets in mission area.

e. Fuel Transfers at Sea.

(1) UNREP refers to the process of replenishing a ship with fuel, cargo, and/or passengers while the ship is underway (at sea).

(2) There are two types of UNREP: Vertical Replenishment and Connected Replenishment. VERTREP refers to when helicopters deliver cargo, mail, and/or passengers to and from a ship. CONREP refers to when ships steam side by side; rig connected lines via pulleys, and transfer fuel, cargo, mail, and/or passengers.

(3) Rendezvous designated (date, time, and location).

(4) Designate refueling base course and speed.

(5) Sequence:

(a) Bridge and Combat Information Center augment manning.

(b) Line handlers stationed on the bow, topside, and stem.

(c) Gunners shoot messenger lines across, which precede Phone and Distance lines, Span Wire, and rigs, hoses, and probes.

(d) Once ready for fuel delivery (P5, then DFM), samples are taken and analyzed.

(e) Pumping and transfer commences.

(f) Reverse process when fueling complete.

(g) Ships separate and depart.

(6) Payment.

(a) Fuel centrally funded.

(b) Document: DD Form 1149.

(c) After-action messages confirm quantity received and quantity delivered (pumped).

(d) Fuel transactions with foreign assets require that the DD Form 1149 be sent to SPCC Mechanicsburg, PA for processing.

f. Aircraft Fuel and Cargo Evolutions.

(1) Shore facilities refuel aircraft (fixed or rotary-wing; for example, helicopters) with either hydrant systems or trucks.

(2) Most ships have helicopters. They have several uses:

- Extension of ship's warfare capabilities.
- Transferring cargo, passengers, and mail.

(3) Types used: SH2 Sea Sprite, SH3 Sea King, CH46 Sea Stallion, and SH60 Sea Hawk.

(4) Flight operations include the following fuel evolutions:

(a) HIFR -- The helicopter will hover over the ship's flight deck. The helicopter crew will lower a messenger line. The flight deck refueling personnel will attach the refueling hose to the messenger line, which will in turn be reeled back into the aircraft. The helicopter crew will then connect it to one of the aircraft fuel receptacles and signal the flight deck crew to turn on the fuel flow. When fueling is complete, the flight deck crew will shut off the fuel. The helicopter crew will disconnect the hose, and lower it back to the flight deck crew.

(b) Hot/cold pump. Hot pump means the aircraft's engines are running while refueling, but cold pump means engines are shut down.

(c) Aircraft pilots have two criteria for accepting or rejecting fuel: clear and bright. They have final approval authority for whether to accept or reject fuel.

g. Additional Logistics Notes.

(1) Carrier On-Board Delivery/Vertical On-Board Delivery.

(a) Fixed-wing aircraft deliver cargo for aircraft carriers (and rest of fleet) by COD.

(b) VOD (helicopter delivery) gets cargo from carriers to the rest of the fleet. VOD, while sounding exactly like VERTREP, only refers to helicopter transfers from carriers to other ships. VERTREP can be performed by helicopters from any source to any ship.

(c) Personnel of all services frequently transit to operational theaters this way.

(2) Airborne Delivery Drop System.

(a) Navy aircraft (P-3 Orion) fly critically needed items to a ship and drop via parachute.

(b) Use must be justified by Urgency of Need and size/weight criteria.

6. Organization of the Air Force.

The Air Force is typically the highest volume user of fuel in a theater of operations. In view of this, an understanding of how the Air Force is organized for fuel support can be critical to ensuring the Air Force has an ample and continuous supply of fuel.

a. Air Force Organization Chart.

(1) HQ USAF. This is located at the Pentagon and is the senior headquarters of the Air Force. It is broken into two entities: the Secretariat (including the Secretary of the Air Force and the secretary's staff) and the Air Staff which is headed by the Air Force Chief of Staff

(2) Major Commands. Major subdivisions of the Air Force are directly subordinate to Headquarters US Air Force. They contain full staffs with management responsibility.

(a) Air Combat Command. It is located at Langley AFB, Virginia. It's mission is to operate Air Force bombers and CONUS-based, combat designated fighter and attack aircraft, and reconnaissance aircraft.

The Air Combat Command's responsibility is to deploy overseas in support of warfighting commands and maintain air sovereignty and wartime air defense in CONUS.

(b) Air Mobility Command. It is located at Scott AFB, Illinois. Its mission is to provide airlift, air refueling, and special air mission and aeromedical evacuation for U.S. forces. The Air Mobility Command supplies forces to theater commands to support wartime tasking.

(c) Air Force Space Command. It is located at Peterson AFB, Colorado. Its mission is to place high value payloads in space with a variety of expendable launch systems. It provides weather, communications, ballistic missile warning, and intelligence to warfighters. The Air Force Space Command provides land-based ballistic missile deterrent.

(d) Air Force Special Operations Command. It is located at Hurlburt Field, Florida. It provides air component of U.S. Special Operations Command, deploying specialized airpower and delivering special operations combat power. It is responsible for unconventional warfare, special reconnaissance, and counterterrorism support to unified commands.

(e) Air Force Materiel Command. It advances, integrates, and uses technology to develop, test, acquire, and sustain weapon systems. It performs single manager continuous product improvement throughout a product's life cycle. The Air Force Material Command is responsible for managing the major product, logistics, and test centers.

(f) Air Education and Training Command. It is located at Randolph AFB, Texas. It recruits, accesses, commissions, trains, and educates Air Force enlisted and officer personnel. The Air Education and Training Command provides basic military training, initial and advanced technical training, flying training, and professional military and degree-granting professional education.

(g) Pacific Air Force. It is located at Hickam AFB, Hawaii. It plans and coordinates offensive and defensive air operations in the Pacific and Asian theaters. The Pacific Air Force organizes, trains, equips, and maintains resources to conduct air operations.

(h) US Air Forces, Europe (USAFE). It is located at Ramstein AB, Germany. It plans, conducts, controls, coordinates, and supports air and space operations to achieve United States national and NATO objectives and U.S. European Command taskings. The USAFE supports U.S. military plans and operations in parts of Europe, the Mediterranean, the Middle East, and Africa.

(3) Numbered Air Forces. This is a level of command directly under a major command. It is a tactical echelon that provides operational leadership and supervision.

(4) Wings. They are a level of command below the numbered Air Force. Each wing has about 1,000 to 5,000 persons. A wing may be an operational wing, an air base wing, or a specialized mission wing.

(5) Groups. They are a level of command below the wing. Groups are formed along functional lines such as logistics, operations, mission support, and medical. A group normally contains from 500 to 2,000 persons.

(6) Squadrons. They are the basic unit of Air Force organization. A squadron may be either a mission unit, such as an operational flying squadron; or a functional unit, such as supply, transportation, or civil engineering.

(7) Flights. They are internal subdivisions of squadrons usually based on a functional responsibility. An example of supply squadron flights would be fuels management, material storage and distribution, material management, and administration.

(8) Elements. They are internal subdivisions of flights. They are used as required to functionally align responsibilities and supervision within a flight.

b. Air Force Fuels Organization and Responsibilities

(1) Headquarters United States Air Force.

(a) Establishes U.S. Air Force policy for managing petroleum resources and energy conservation matters.

(b) Validates major command-generated wartime fuel requirements.

(c) Develops petroleum budget estimates and accomplishes other financial and commodity management responsibilities.

(2) Major Commands.

(a) Reviews and validates fuels vehicle and equipment authorizations.

(b) Consolidates, validates, and submits both peacetime and wartime fuels and missile propellant requirements to DESC.

(c) Develops fuel support plans to support wartime taskings.

(3) Directorate of Aerospace Fuels, San Antonio Air Logistics Center.

(a) Operates Air Force laboratories and oversees the quality control process at Air Force bases.

(b) Provides technical guidance through their Petroleum Technical Assistance Team.

(c) Processes fuels transactions applicable to the Fuels Division, Defense Business Operating Fund.

(4) Base Fuels Management Flights.

(a) Responsible for base level receipt, storage, quality control, distribution, and issue of aviation and ground fuels and for receipt and storage of cryogenics.

(b) Flight is manned according to a core strength target of 75 for a typical base and adjusted with additional personnel for varying missions.

(c) Flight is managed by a two-person team normally consisting of a company grade officer and a senior noncommissioned officer (E-8/E-9).

(d) Typical fuels flight is organized and tasked as follows:

1 Fuels Management Team: Responsible for overall management of the flight. Specific responsibilities include budgeting funds for equipping and supplying flight operations and developing base fuels support plans. Ensures required minimum fuel inventory levels are maintained and that operational technical orders are complied with for all fuel handling and servicing operations

2 Quality Control and Inspection Element: Eyes and ears of the fuels management team. Performs internal quality control inspections on all flight operations and provides detailed reports to the fuels management team. Operates the base fuels laboratory and maintains a fuel sampling and testing program.

3 Operations Element: Comprised of three areas: fuels storage, fuels distribution, and the fuels control center. Responsible for physical receipt, storage, and issue of all fuels and cryogenics products.

4 Fuels Accounting and Administration Element: Responsible for inputting all fuels receipt and issue transactions into the Fuels Accounting System. Maintains accountability of fuel inventory. Prepares and maintains all formal correspondence, reports, and publications.

5 Fuels Support Element: Responsible for internal technical and ancillary training program, material control, and the flights mobility program.

c. Refueling Operations.

(1) Air Force refueling operations can be performed either through the use of hydrant systems or along-side refueling operations. A hydrant system is simply a system of pumps, pipes, and valves used to conduct refueling operations at an airfield. Along-side refueling is refueling operations conducted using tank vehicles.

(2) The Air Force requires that 85 percent of fuel be issued using a hydrant system or 85 percent of aircraft being refueled be from a hydrant system. The use of a hydrant system is the safest and most efficient method of refueling aircraft at an airfield.

(3) The base fuels management flight provides equipment and personnel to conduct refueling operations on the air base and operates 24 hours a day with three 8-hour shifts.

(4) The fuels management flights normally have a 30-minute response time from the time of notification of refueling or defueling operations until the operation begins based on the priority of the operation.

(5) There are seven types of refueling operations conducted by the Air Force:

(a) Hot or Rapid Refuel: The aircraft is refueled while one or more engines are running.

(b) Hot or Rapid Defuel: Fuel is pumped out of the aircraft while one or more engines are running. Keeping the engine running allows the fuel transfer pumps of the aircraft to speed the defuel process.

(c) Integrated Combat Turnaround:

1 Used to recover and relaunch aircraft in the minimum amount of time.

2 The ICT involves simultaneously performing refueling, munitions loading, or specified maintenance functions. This makes the process similar to Army FARP procedures.

3 ICTs were formally reserved for emergency combat conditions, but are conducted as routine operations on the air base.

(d) Hot Integrated Combat Turnaround:

1 ICT conducted with one or more engines running.

2 Hot ICTs are reserved for combat operations and combat training as authorized by the MAJCOM.

(e) Multi-source Refueling: Large aircraft such as the C-5, C-141 and KC-10 require much larger amounts of fuel and are often refueled from multiple sources such as a hydrant system and a refueling vehicle or several refueling vehicles.

(f) Concurrent Servicing: Refueling operations conducted either with passengers on-board or in conjunction with maintenance functions.

(g) TAB VEE or In-Shelter Refueling: Refueling operations conducted in hardened or alert shelters. The authority to conduct TAB VEE operations is granted by the local commander and must be accomplished through a hydrant system.

d. Navy Reserve Capabilities.

(1) The Navy's ELS is headquartered at Cheatham Annex, Williamsburg, Virginia. Manned primarily by reservists, this command, as its title implies, provides logistics support (cargo handling, port receiving, and fuel support) to expeditionary forces.

(2) The ELSF's fuel mission is met by ABFC tank farm units.

(3) ELSF has 10 of these 22-person units. Each unit is comprised of a Lieutenant Commander CO; a Lieutenant XO; Chief Petty Officer (the equivalent of an NCOIC); and 19 enlisted personnel primarily from the Navy's Construction Battalion ("SeaBee") and engineering specialties.

(4) The ABFC units are trained such that when they are mobilized, they will be responsible for Navy expeditionary onshore fuel support (when other support is not available or adequate).

(5) The ABFC tank farm units have two missions: to augment fixed facilities, and to establish/operate tactical fuel facilities.

(6) Each ABFC unit is required to attend a 6-day course conducted at the U.S. Army Quartermaster Center and School, Fort Lee, Virginia. This course is extended to a full 10 days to incorporate unit proficiency certification, which each unit is required to complete every 4 years.

LESSON 23

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson, which contains the portion, involved.

1. The Secretary of Defense is one member of the National Command Authority. Who is the other member?

   A. The President of the United States
   B. The Secretary of the Army
   C. The Vice President of the United States
   D. The Chief of Security

2. The Joint Staff is organized into how many directorates?

   A. 4
   B. 6
   C. 8
   D. 10

3. Who directs and controls current operations?

   A. The J-4
   B. The J-3
   C. The J-7
   D. None of the above

4. BPWRS is limited to a stockage level for mobility requirements. BPWRS is also limited to which of the following?

   A. Strategic lift, Strategic air operations, Civil defense requirements, and Logistics operations support of strategic operations
   B. Logistics operations in support of strategic operations, Strategic lift, CONUS field exercises, and Civil defense requirements
   C. Strategic lift, Strategic air operations, Joint training exercises, and Logistics operations in support of strategic operations
   D. Non-Logistics operations in support of strategic operations, Strategic lift, CONUS field exercises, and Joint training exercises

5. Who implements the fuel standardization policies as outlined under DOD policy?

   A. The Petroleum and Fuels Committee
   B. The Class III Accountable Officer
   C. The Secretaries of the Military Services
   D. The J-6

6. Who is responsible for preparing emergency plans and developing preparedness programs for petroleum products, natural gas, coal, and electric power?

A. The Environmental Protection Agency
B. The Environmental Office
C. Department of Energy
D. The Wilderness Commission

7. What is the geographical area behind the corps rear boundary known as?

A. The Communications Zone
B. The corps rear
C. The LOD
D. The tactical operations

8. Who is responsible for the detailed planning of the petroleum supply organization and distribution?

A. TAACOMC
B. COSCOM
C. DISCOM
D. Petroleum Group

9. Who provides GS petroleum support (receive, store, issue and transfer) to DS petroleum units and high volume users throughout the theater?

A. The Medium Truck Company
B. The POL platoon
C. Petroleum Supply Company
D. Division Support Command

10. Which of the naval divisions provides management oversight to the Navy aircraft-refueling program at 27 CONUS locations?

A. Operations
B. Maintenance
C. Supply
D. Security

11. How many types of Underway Replenishment are there?

A. 2
B. 3
C. 4
D. 5

12. What is HIFR?

A. Helicopter In-Flight Refueling
B. Hot Internal Fill Refueling
C. Helicopter Initial Flight Refueling
D. Hot International Flight Refueling

13. How much fuel does the Air Force require to be issued using a hydrant system?

A. 75 percent
B. 80 percent
C. 85 percent
D. 90 percent

14. Where is the Navy's Expeditionary Logistics Support Force (ELSF) headquartered?

A. Williamsburg, Virginia
B. Fort Lee, Virginia
C. Cheatam Annex, Williamsburg, Virginia
D. Alexandria, Virginia

LESSON 23

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item Correct Answer and Feedback

1. A. President of the United States, (page 23-2, para 1(a)).
2. D. 10, (page 23-3, para 2(e)(2)).
3. B. The J-3, (page 23-5, para (3)(c)).
4. A. BPWRS is limited to a stockage level for mobility requirements, strategic lift, strategic air operations, civil defense requirements (when approved by the Under Secretary of Defense, Logistics) and logistics operations in support of strategic operations such as load out of ships and aircraft in flight refueling operations, (pages 23-6, (3)b)).
5. C. The Secretaries of the Military Services, (page 23-7, 2c (1)(b)).
6. C. Department of Energy (DOE), (page 23-12, (d)(1)).
7. A. Communications Zone (COMMZ), (page 23-13, para 4(a)(2)).
8. D. The Petroleum Group, (page 23-15, d(2)(a)).
9. C. The Petroleum Supply Company, (page 23-17, 4d(4)9a).
10. A. Operations, (page 23-22, (5)(b)).
11. A. 2, (page 23-23, e(1)).
12. A. Helicopter In-Flight Refueling, (page 23-23, (a)).
13. C. 85 percent, (page 23-27, (c)(2)).
14. C. Cheatham Annex, Williamsburg, Virginia, (page 23-29, d(1)).

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